JULY 28, 1958 Price 50 cents

RESEARCH and DEVELOPMENT news edition

# Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN
RESEARCH AND DEVELOPMENT

## the little man can't protect his patents...

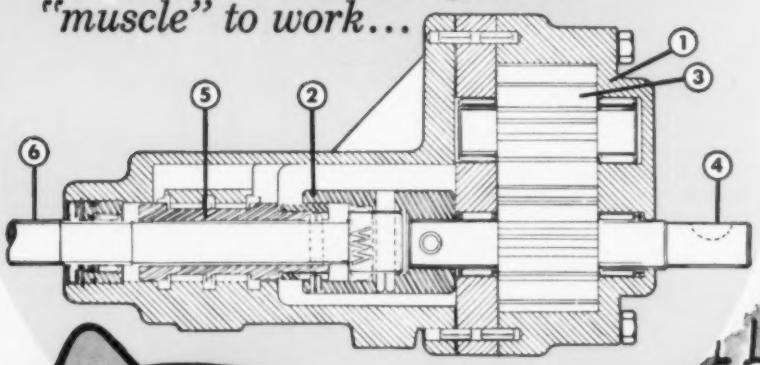
see page 26

*Overtime pay for engineers?* see page 29

*FROM IDEA TO FORM . . .*
*a loudspeaker telephone . . .* see page 30

E B POWER GS
UNIVERSITY MICROFILMS
313 N 1 ST
ANN ARBOR MICH A

*a pound of resistance puts this "muscle" to work...*

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# your index

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A 16-page printed index of all editorial content in issues of the first six months of 1958 (Vol. 29) is now ready. Copies may be obtained by writing *Index-Vol. 29* in the space marked "Special Data" on the Readers Service Card, p. 41.

Hereafter the Index will be issued twice each year, in July and January, and copies will be sent free on request as long as the supply lasts. A limited supply of the Index for 1957 (Vol. 28) is still available.

# coming next week . . . the DESIGN edition for August 4

FEATURING

- **Silicone rubber sponge**
  With better sponging grades and process controls tolerances can be predicted and rejects cut.
- **Which type of torque-limiting device**
  17 ways to prevent motor overloading with hydraulic, magnetic, mechanical and electrical limiters.
- **Stress corrosion in metals**
  Chemical environment plus stress may be tough to resist. Here's how design can help.
- **The small gas turbine**
  Its small size and light weight make it an ideal power package.
- **Elastically supported cantilever beams**
  Formulas and diagrams to figure deflections for 8 beam mountings.
- **13 ways to couple shafts**
  Permitting axial play only, or universal types with angular play as well.

# Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news edition

July 28, 1958 Vol. 29, No. 30


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# Product Engineering . . . . . SIDELIGHTS

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● **Inevitably, loudspeaker telephones** (p. 30) will find their way into homes where women can get at them. Is this progress? Maybe. We do, however, mourn the passing of a glamorous dream. Movie queens invariably carried their boudoir phones across half the apartment to a chaise longue for romantic conversations. Now they'll have to shout sweet nothings into space.

● **New engineering units** (lb, ft, sec, etc.) aren't patentable (p. 26) and so we plan to make free use of the one that just crossed our desk. Coleman Engineering Co. announced a high-acceleration, short-stopping test sled whose braking system can absorb the power of "20,000 Porsche automobiles. This is the equivalent deceleration of a sports car from 100 mph to standstill in 2 ft." By a similar calculation PRODUCT ENGINEERING uses the power of two Volkswagens to light our office and run our air conditioner. Our editors travel an average of 10 Volkswagen-hours every day. We mail some 200 Volkswagensful (Volkswagenfuls?) of magazines every month. Don't laugh, it may not be a sports car, but it's small, foreign, and costs less than the "low-priced three."

● **At last an engineering conference** is being planned in a straightforward, businesslike way. The Electronic Industries Assn. (formerly RETMA) will have its third conference on Reliable Electrical Connections in Dallas, Dec. 2, 3, 4. Here are some of the ground rules: "The usual authors of papers will be there, but you will not have to listen to them read their papers. Papers will be published and offered for sale on Oct. 15. You can read the papers and prepare questions beforehand. You will be able to pursue a subject to its bitter end in order to get the facts. You will not be distracted by exhibits. You will not be solicited by men who want to sell you something. You will not be entertained except as you entertain yourself. There will be no planned lunches or dinners." If these good intentions are followed through and copied, EIA will have done more for American engineering than Isaac Newton.


ABP JULY 28, 1958

**Product Engineering**

*A McGRAW-HILL PUBLICATION*

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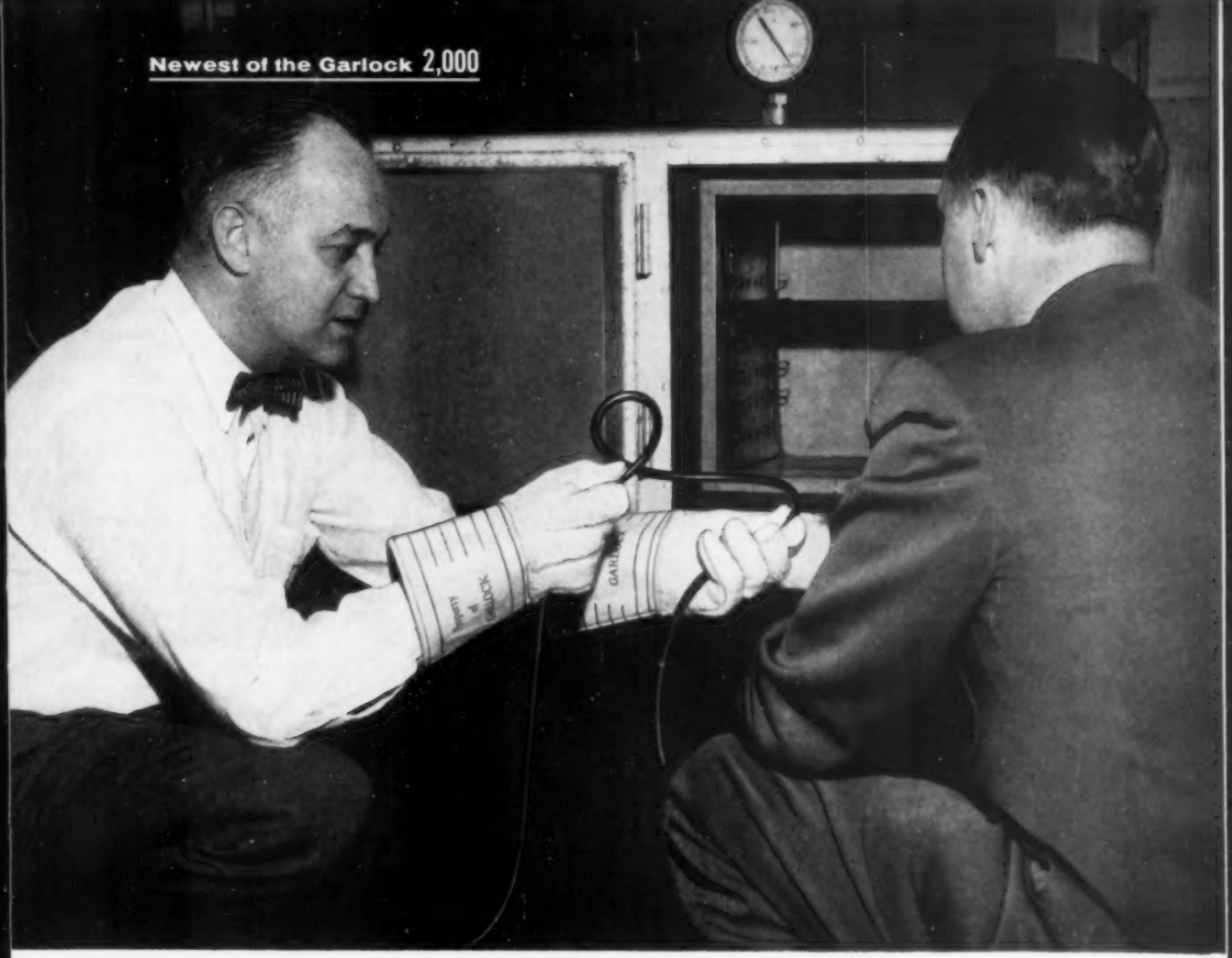
READER TO EDITOR

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# READER TO EDITOR

## Hot Water Tablet

*To the Editor:*

In your June 16 edition (p. 50) Mr. C. Van Tassel asked, "Why don't they research and develop an instant hot water tablet?" Our laboratory has developed a heat capsule that in one minute will heat to just below boiling a volume of water equal to 18 times the volume of the capsule. The unit is hermetically sealed, and the reaction is started either electrically by using a small 1½-volt cell or chemically by depressing a mixing plunger. One capsule should provide one cup of instant coffee for less than 10 cents.

—Roger A. Lloyd
*Alloyd Engineering Laboratory*
*Verona, Wis.*

## Chain Engineers to a Drawing Board?

*To the Editor:*

To quote from "An Engineer's Profile" (June 16, p. 33), "Engineers do not delegate authority well" and "Engineers prefer methods, objects and process to either ideas or people." These statements certainly do not reflect engineers' abilities as leaders, which abilities they must possess as executives in management. Possibly we should chain them to drawing boards, and thus prevent their further entry into management circles, lest we find ourselves in the same unfortunate position as Europe.

—J. M. Kossarides
*Model Engineering & Manufacturing, Inc.*
*Huntington, Ind.*

## Don't Axe a New Idea

*To the Editor:*

Your readers (June 9, p. 26) sure proved me wrong when I claimed that the automatic brake system failure shutoff is based on faulty principles. The lesson, "Don't axe a new idea too soon" is one I should have known for I am usually on the other side of the fence; fending off previous criticisms to my own new ideas! So keep on with "Why don't they Research and Develop."

American inventors have shown repeatedly, that many so-called "principles" are not principles at all.

—George H. Amber
*Amber & Amber Consulting Engineers*
*Detroit, Mich.*

## We Need Wisdom

*To the Editor:*

The five "Points of View" (June 30, p. 24) are interesting because one makes sense. The others echo eight months of "we have ideals" and "seek to develop leadership" in articles and TV interviews. Norman Cousins makes sense by noting that we need wisdom and a new world view. This could start with an entirely new attitude, based on Freedom of Thought, in order to eliminate feuds and international tensions.

Education does not produce wisdom! The other four views prove this conclusively. Dr. H. L. Bevis says: "We cannot neglect our political cultural and spiritual growth." The lack of such "growth" is too obvious. If the "integrated resources of ourselves and the nations of the free world" are our greatest strength, we are out on a limb. Integrated with Latin America? Or Laos? How about a bit of integration at home, first?

Dr. R. Goheen wants to select "minds capable of scientific excellence." Can Princeton's faculty select them at the age of 2, 10 or 20 years? "Preserving and strengthening our educational ideals" has been stated for decades, but what are the actual results regarding wisdom, especially in education? Dr. J. R. Dunning recognizes aggressive despotism; yet, it seems far from the truth that "doubling the proportion of our national income devoted to education," or "raise the teacher's salaries" will buy quality in education, or wisdom. Who instigated the "sloth and slackness" in our homes and communities by entrenching progressive education?

Dr. L. V. Ginger recognizes a Soviet "indoctrinated citizenry." Are we free from indoctrinations? What wisdom divided Germany in 1945? "We seek to develop leadership and high talent." Certainly, but has our mass "education" done it?

Our teachers are told what to teach, the students are there in droves; yet wisdom is absent. Many teachers may miss this truant, but no excuse for such absence is required!

—Whitney E. Greene
*Los Angeles, Calif.*

• *To quote Alexandre Dumas, "All human wisdom is summed up in two words —wait and hope."* —Ed

# American...

## DEVELOPMENTS TO WATCH...

## New coatings, combining ceramics . . .

. . . with metals, are promised by an electrophoretic technique just revealed by Vitro Corp. It's one result of a long-term research effort aimed at developing heat- and corrosion-resistant materials for nuclear reactors.

Like electrolysis, electrophoresis involves the movement of charged particles through a liquid under the influence of an electrical potential. In electrolysis, though, the particles are in solution. They are dissociated molecules. In electrophoresis, the particles are larger than molecules and are simply dispersed through the liquid—opening the possibility of depositing many materials which can not be dissolved by standard means.

As Vitro explains it: "In electrophoretic deposition, an electrostatic field is established between two electrodes immersed in a colloidal dispersion of charged particles, causing migration of the suspended particles to one of electrodes." A part attached to that electrode can thus be coated with the colloidal material; and, "even irregularly shaped objects are coated with excellent uniformity and reproducibility of coating."

Mixtures of metallic oxides and ceramics can be codeposited by this method. Then, when the coated part is sintered in a reducing atmosphere at high temperature, a metal matrix is formed. It entraps the ceramic particles, forming a cermet which "retains the structural strength of the metal and the oxidation resistance of the ceramic at temperatures over 1300 F."

Looking ahead, Vitro engineers foresee coatings even stronger and more heat resistant being achieved by successive, layered finishes and by new combinations of metals and ceramics. Right now, the company is working with oxides of chromium, nickel and cobalt; variety of carbides, silicides, and borides; and base metals ranging from molybdenum to low-alloy steels.

Also coming up: electrophoretic coatings that form both low- and high-friction elements, and one that serves as a sacrificial lubrication layer.

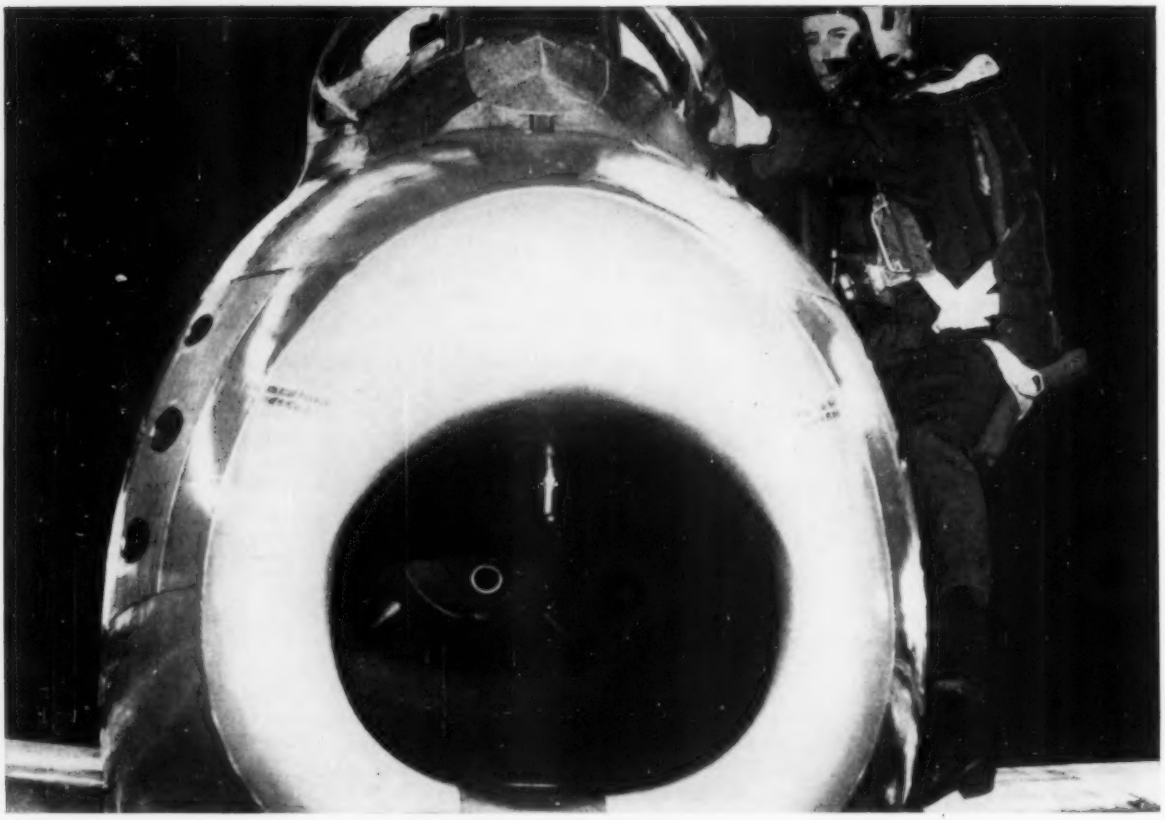
## Lower-cost, weatherproof adhesives . . .

. . . which "can be used in many phenolic applications" are promised by Rayonier, Inc., as a result of development work on chemicals made from wood bark (*PE—June 16, p. 11*). Unveiled recently is a silvichemical intermediate, HT-120, said to yield a thermosetting adhesive for plywood that "meets all present commercial requirements" for exterior use, is stable at room temperature, and cures readily. It may be the long-heralded breakthrough that will bring many other useful materials from wood bark.

## More aluminum is coming . . .

. . . from Ormet (Olin Mathieson-Revere) Corp.'s new integrated operation now nearing completion. Already at work is Ormet's reduction plant near Clarington, Ohio. Now, the Louisiana alumina plant pictured here is swinging into line. By fall, OM expects also to have a rolling mill in operation at Clarington to handle its share of the reduction plant's output. This, in addition to OM's Tenn., Ill., Miss., and Calif. mills, and Revere's Baltimore and Chicago plants, will make the metal (120,000 tons of it a year) available on a nationwide basis.

**Sodium aluminate pours into precipitator** at new Ormet plant. It's one step in process that turns bauxite into alumina. —ARG



## *in here . . .* ***a tough new alloy***

Everything this jet fighter swallows hits those buckets and blades, including nuts, bolts, pebbles, rocks, dirt, sticks and even birds.

Often, the result is a ruined engine, a crippled airplane. That's why Carpenter metallurgists devote a good share of their efforts to improving the tough alloys used for compressor and turbine parts and fasteners.

**And now, they've come up with a brand new alloy steel—LAPELLOY "C", U. S. Patent No. 2,816,830.**

It is more ductile and has more impact resistance than the conventional Lapelloy long used in jet engines. Its structure is more homogeneous and it has more uniform fabrication properties. Its strength is excellent at both room and elevated temperatures.

New LAPELLOY "C" is made by the exclusive Carpenter MEL-TROL process. MEL-TROL makes possible new standards of uniformity and predictable performance in specialty steels by removing the causes of inconsistent centerline quality so often found in alloys made by conventional methods. In addition to new LAPELLOY "C", Carpenter offers a wide selection of other MEL-TROL alloys for elevated temperature service.

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# American ...Washington

## DEVELOPMENTS TO WATCH...

## Watch the growing trend of Navy to go underwater . . .

Within the next ten years, some Navy officers claim, the main striking force of the Navy will be virtually an "invisible fleet." It will consist of high-speed, far-ranging, nuclear-powered submarines prowling the ocean depths armed with nuclear weapons.

Coupling the nuclear sub with the 1,500-mile Polaris is still the "big" punch of Navy. But, possibly even more lethal is its latest underwater missile, Subroc. Primarily, this is an atomic warheaded weapon to be used against enemy submarines. But, some observers are claiming the weapon is a more sophisticated approach to underseas missiles than Polaris. It has a more complex central system. Navy already has the 1,000-mile Regulus II installed in subs.

The new weapon system will be installed initially in submarines, including the now Polaris-toting subs. Later it may be put on surface ships as well. It is designed to detect enemy submarines at long range, compute their course and speed, and fire the missile to destroy it. The missile will be fired out of torpedo tubes from underwater, then rise to the surface and be propelled through the air by a powerful solid-fueled rocket to the vicinity of the enemy sub. The rocket then drops off and the nuclear -warhead reenters the water and homes in on the target.

Ultimate goal of the Navy is to get the weapon system perfected so that it can detect and kill enemy subs at up to 200-mile ranges. Ranges up to 2,000 miles are being talked about for the missile itself. Idea is that the weapon can also be used against enemy shore targets. Estimates are that 20 to 40 of the weapons can be carried in a submarine—conventional as well as nuclear powered.

Navy recently awarded a $65-million contract to Goodyear Aircraft Company to develop the complete weapons system, including production and tooling methods. Goodyear will work with Navy's Ordnance Lab, Kearfott Co. of N.J., and Librascope of Glendale, California, on the project.

Big reason Navy is going all out in its underseas weaponry is that virtually all land targets of the earth are within range of the missile-carrying subs—undetected by the enemy.

## Make policies clearer to industry . . .

and give back more authority to R & D working levels. That's a key recommendation that the Scientific Advisory Board to the Air Force has made. The Board, headed by H. Guyford Stever of MIT, has recently completed an over-all study of Air Force's R & D efforts. It is always difficult to appraise the effectiveness of such reports.

Here are some major recommendations, however: Air Force's Air Research and Development Command should be realigned along functional lines, ie, research, technical development, weapons systems, testing, etc.; the weapons system concept should be hauled up for a new appraisal—in some respects it has been carried "too far", the report states; pump more money into research, state-of-the-art development, and development of new weapons.

Less control from the top is desired by the Stever committee, too. It slapped at the complex net of watchdogging done on new projects, often guised as money-saving controls. "Over the long term," the Advisory Board says, "it will be far cheaper to risk the occasional failure of a project than to have excessive (control) . . . encumbering the program and lengthening radically the development cycle . . ."

## The air has been cleared . . .

over income derived from patents. The Internal Revenue Service has finally tossed in the towel in trying to hold to its ruling that annual royalties paid on patent rights must be treated as ordinary income. Four years ago, Congress changed the Internal Revenue code so that such income could be handled as a capital gain. But, the Internal Revenue Service refused to interpret the legislation that way, and stuck to its "ordinary income" ruling.

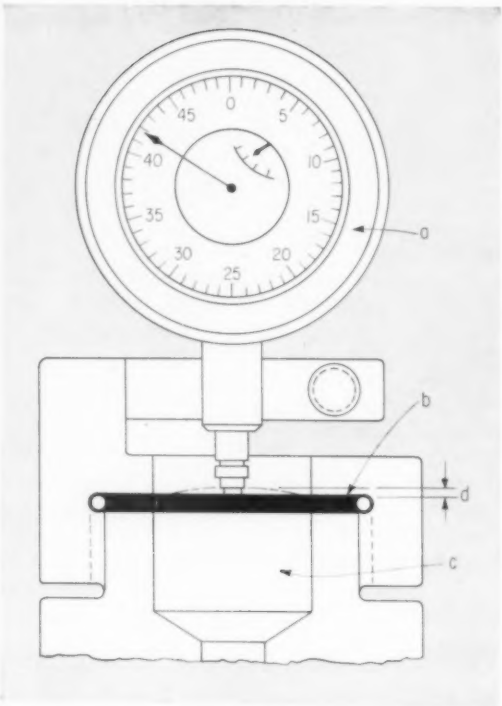
Subsequently, tax courts have consistently ruled against the IRS on the matter. Now, revenue has conceded the issue. It will "no longer take the position, in litigation or administratively" that the mere retention of an interest resembling a royalty by the assignor or transferor of a patent, "in and of itself prevents capital gain treatment."

# World-wide ...

## DEVELOPMENTS TO WATCH...

## To test high-viscosity plastic resins . . .

. . . used for pressure transmission in machine tools, an East German engineer has developed the manometer diagrammed here. It's an adaptation of a simple pressure meter, with a steel membrane serving as deflection indicator. The tester has a standard dial gage (a), with its feeler point resting on the steel membrane (b). This, in turn, rests on the surface of the resin (c). According to *Fertigungs-Technik* (an East German publication), deflection (d) of the membrane is directly related to pressure in the plastic, and the manometer is readily adapted to any existing system, allowing exact control of pressure, and permitting more accurate design of driving elements.




## TV tube only 3 in. thick . . .

. . . and "especially suitable for color," has been designed by Dr. Denis Gabor of London's Imperial College. It's a 12-in. glass tube that uses conventional phosphors; but the electron gun, mounted at top rear of the tube, shoots downwards and the electron beam is bent around a "reversing lens" to bring it back up into position. A charged electrical grid then focuses the beam on the screen.

## Thixotropic coating . . .

. . . providing corrosion prevention "equivalent to at least 3 coats of paint" is offered by Evode Ltd., Stafford, England. It's an asphaltic bituminous gel, containing an active corrosion inhibitor, which can be applied in single-layer thicknesses to 0.030 in.

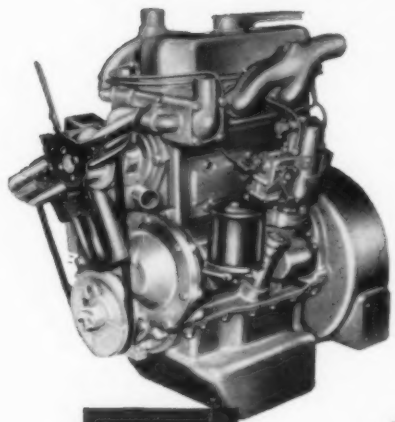
The thixotropic nature of the new coating makes it easy to brush on; yet, the compounder points out, makes it "stay put," even on vertical surfaces, and gives it "remarkable resistance to flow even at elevated temperatures." (Thixotropic means that the coating's gel structure breaks down as it is worked with a brush, but reestablishes itself when the material comes to rest so that the coating does not drip or sag.)

The new Bitugel Heavy-Duty anticorrosive coating dries in air and remains "permanently flexible." While aimed primarily at the maintenance field, it can also be used for automotive undercoating, protection of outdoor transformers and equipment designed for use in corrosive atmospheres.

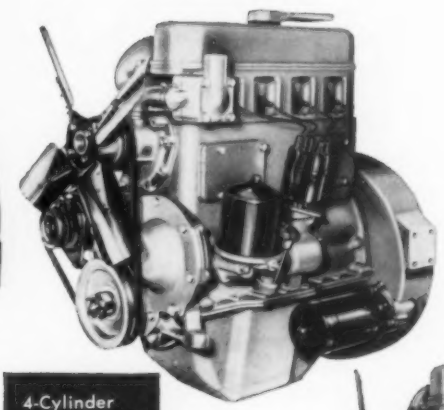
## Big new zinc find . . .

. . . in Canada will be developed despite current weakness in demand. Nine companies, including Noranda, McIntyre, and Canadian Exploration, are joining hands to exploit the deposit in the Mattagami area of Quebeck Province. It will likely be some time before any metal starts coming out, though. Even the preliminary exploration is not yet complete—and outlining the area may take 18 months or more. That would put 1961 as earliest date at which operations could start.

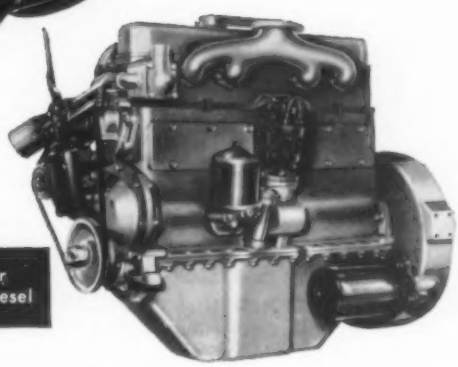
# You can power your whole line with HERCULES engines



3-Cylinder
Gas or Diesel



4-Cylinder
Gas or Diesel



6-Cylinder
Gas or Diesel

## and get 18 HP ratings with 3 basic engine sizes

With three bore sizes in 3, 4, and 6 cylinder models, Hercules new DD diesel and GO gasoline (or LPG) engines offer 18 horsepower ratings from which to choose your power.

Diesel, gasoline and LPG-engines in the same number of cylinders have complete mounting interchangeability for "production-line" selection of power plant.

Your customers will welcome the simplified maintenance built into every Hercules DD and GO engine, too. Many spare parts will serve both 3-cylinder gasoline and 6-cylinder diesel engines—and everything between! There's an illustrated folder which demonstrates this parts interchangeability that's yours for the asking.

If you'd like more information on specific engine selections for your equipment line, call the Hercules representative near you or write to Hercules Motors Corporation, Canton 2, Ohio.

*HERCULES ENGINES*
*... Sold and Serviced the World Over*

**HERCULES**

HERCULES MOTORS CORPORATION
Canton, Ohio

# What's happening in SCIENCE

## Does anti-matter matter?

Universes that annihilate each other, nuclear particles that don't obey long-sacred laws . . . these are the stuff of which anti-matter dreams are made. The facts, though, are no stranger than the square root of minus one—less strange, in fact, since anti-matter particles have been shown to exist, while the square root of minus one does not.

The theory of anti-matter is simply that, for every electrically charged atomic particle there is or can be an equal and oppositely charged particle. The positron, for instance, is an anti-matter particle—the electron's opposite number.

In the case of particles which do not carry a charge, the anti-matter particle is one of equal weight that differs in magnetic properties or direction of spin. Put the two together, and one cancels the other out.

When two charged particles meet, the cancellation produces energy (generally as gamma rays) and neutral particles. When neutral particles meet, one or the other may break up or change its energy or direction of motion, again releasing a considerable amount of energy. More, as a matter of fact, than is released in the thermo-nuclear fusion of hydrogen atoms.

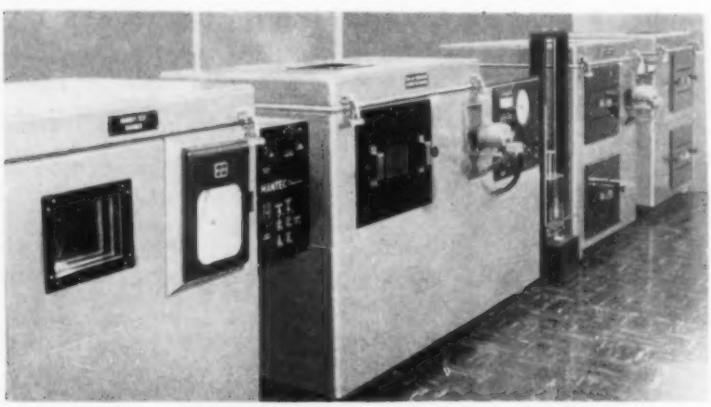
Obviously, matter and anti-matter particles cannot continue to exist in the same universe. Eventually—even in a very diffuse medium—they would meet and destroy each other. This has led to the postulation of anti-matter universes, and to studies of universes we know—to see if there is evidence of such annihilation collision having occurred between universes sometime in the past. So far there is no clear proof.

Why is anti-matter important?

The development of anti-matter theory, and growing conviction that atomic-particle motions create or control gravity (*See below and PE—June 30, p. 10*) has led some to postulate an anti-gravitational force. This, if demonstrated, would mark a revolution indeed, since it would run counter to the basic principles of relativity.

The huge amounts of energy released in collision reactions might suggest another way to use atomic power. But scientists point out that far more energy is required to produce such anti-matter particles as antiprotons and antineutrons than is released when the collision takes place. Indeed the University of California scientists who have pioneered in producing anti-matter particles state clearly "no practical application of this discovery is now in view. There is no known way, for example, that an antineutron could be used to generate power."

What's important, though, is that proof of the existence of anti-matter, and our ability to produce it, gives us greater insight into the atomic nucleus, may throw new light on the greatest mystery force—gravity—and marks another step forward in scientific progress.



**Packaged laboratories** for environmental testing *(PE—May 26, p. 20)* are now offered by Mantec, Inc., El Segundo, Calif. This one, built for Ratigan Electronics, includes automatically programmed humidity-temperature-vibration chamber, altitude-temperature chamber, shock machine, two high-low temperature chambers.

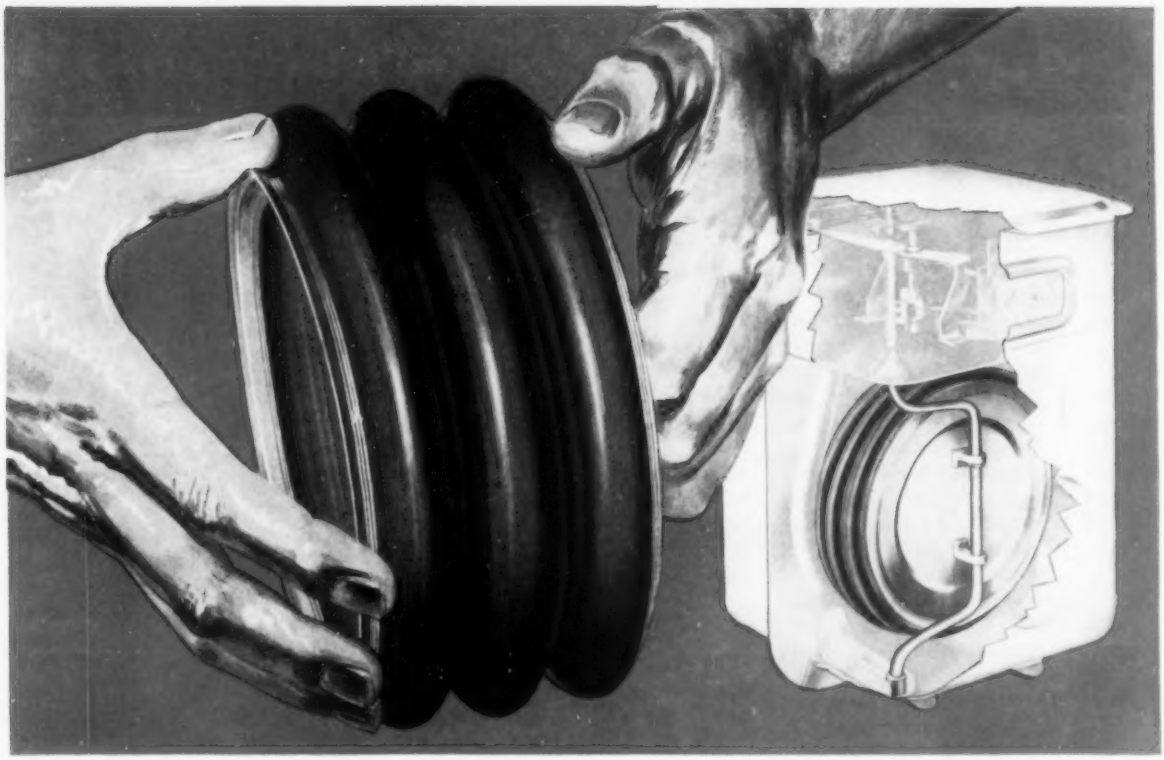
## briefs . . .

**Gravity award winners** for 1958, like the prize essay in last year's Gravity Research Foundation's $1,000 annual contest, reflect hope that study of atomic particles and forces will provide a key to gravitation. Winners this year were Guiseppe Cocconi and Edwin Salpeter with an essay on "A search for anisotropy of inertia." Among last year's leaders was "On the gravitational interaction of matter and anti-matter" by Philip Morrison of Cornell U. and Thomas Gold of Harvard.

**New radiation center, at Dawsonville,** Ga., scheduled for operation this fall, will have a 10-megawatt reactor, irradiation facilities, and numerous other features that promise to make it a unique scientific center. Built for the Air Force and operated by Lockheed Nuclear Laboratories, it will aim at solving problems of aircraft nuclear propulsion (*PE—Apr. 14, p. 52*).

**Trends in engineering labs** will be discussed by representatives of Gulf, California Research, and General Motors at next month's SAE National West Coast meeting in Los Angeles. Also receiving close attention: brake and wheel design, heavy-duty fuels and transmissions.

**Middle road to ion propulsion** (*PE—Feb. 24, p. 14*) will be explored by Vitro Corp. Aiming at exhaust velocities midway between those of chemical fuels and the rate achieved with high-voltage accelerators, it will use high-intensity electric arcs to generate high-temperature electrode-vapor plasma jets. Air Force Office of Scientific Research is sponsoring the investigation. —ARG



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**Diaphragms coated with THIOKOL'S ST have**

- **greatest resistance to most gases and solvents**
- **very low permeability to vapors and liquids**
- **maximum low temperature flexibility**

Because of these outstanding properties, major improvements are being made in diaphragms. For example, gas meter diaphragms are now being made with cotton, coated with THIOKOL's Type ST that last longer and are more efficient than conventional diaphragms. THIOKOL Polysulfide Rubber Type ST provides maximum resistance against chemicals and solvents either in condensate or gaseous form. These coated diaphragms are absolutely air-tight and gas-tight. There is no "dressing" on this type of diaphragm which can leach out and cause the diaphragm to become stiff. Because of the increased performance and uniformity of material coated with THIOKOL's ST, thinner diaphragms are being used with more rapid cycling movements enabling the size of the unit to be reduced.

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Gentlemen: Please send me further details about THIOKOL Polysulfide Synthetic Rubber.

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# What's happening in MATERIALS

## Uranium: Come and get it

From now on, finding uses for uranium will be more of a problem than getting it. As predicted here early this year (*Jan.* 6, p. 34), uranium has, at long last, been freed from security regulations. True, the material being made available is "depleted" uranium—most of the fissionable U 235 has been removed, and it will not be sold in metal form. But for all except nuclear uses it is identical to the natural element.

In pre-bomb days, uranium's major applications were as a colorant for ceramics and glass and as an ingredient of photographic emulsions. However, it is a heavy element (specific gravity: 18.68), and might prove useful as a balance, counterweight or radiation shield (PE—July 21, p. 62). Prospective users should recognize though, that uranium, while not very toxic, is far from easy to handle (see below).

The newly available uranium is in the hexafluoride form which is the end-product of AEC processing. Its base price, f.o.b. Paducah, Ky., is $5 per kg of contained U. Purchasing information may be obtained from the AEC Office of Industrial Development, Washington 25, D. C.

## How to handle the problem metal

Uranium is an intractible metal, brittle, hot short, easily corroded at even moderately elevated temperatures. Its powders are highly pyrophoric, its chips moderately so. But this recently freed metal (see above) has one black mark on its record it doesn't really deserve:

As the Association of Casualty and Surety Companies, 60 John St., New York 38, points out, uranium has some toxicity and radioactivity, but few cases of uranium poisoning have been reported. It is much more of a fire than a health hazard.

In a bulletin prepared for member companies, but made generally available because of its wide interest, the Association outlines present practice in uranium handling and use, and also provides data on physical properties and processing.

## briefs . . .

**New finish for Type 430** stainless steel is offered by Armco Steel Corp. Aimed at providing a "soft, lustrous surface" for appliance trim, kickplates, switchplates, and the like, it's priced on the same scale as No. 1 and 2 finishes for cold-rolled 430 strip; will be called "Softone."

**Polystyrene will be "piped"** from Cosden Petroleum Corp.'s new plant to its major customers, with, Cosden says, "considerable cost saving advantages." For users of more than 400,000 lb, Cosden expects the new system to save as much as 10%. The system utilizes trucks and railroad hopper cars to and from which material is transferred in bulk by pneumatic conveyors. The savings, of course, comes from bulk rather than drum handling.

For customers purchasing smaller (but still substantial) amounts, prices for general-purpose polystyrene will range from 20.25¢ to 22¢; for high impact, 28.75¢ to 30.50¢.

**Beryllium bolts** have been developed by Voi-Shan Mfg. Co., Culver City, Calif., and are now under test. First reports on the bolts, made by a new hot-forging process, indicate a tensile strength of 95,000 to 100,000 psi, and a shear strength of 60,000 to 65,000. Fatigue and other data are now being assembled. Voi-Shan terms the manufacturing process a "major breakthrough," but admits that, even with the new technique, beryllium bolts will be far from cheap—about 20 times the cost of alloy-steel aircraft bolts. (For additional information on beryllium, see *PE*—*Mar* 17, *p.* 66.)

—ARG

### Record Breaker?

**This worm feed** for a chemical mixer may be the largest machine part ever made of acrylic plastic, says Rohm & Haas, material supplier. More than 4 ft long and 15 in. dia, the part is built up from a series of laminated, cemented disks (stock that size is not produced). Primary reason for choice of the material was to eliminate chance of metal contamination; but R&H notes that this acrylic plastic also has the required strength, can be machined to close tolerance.

*Nature at her best is beyond improving...*

Imported

Castell

lays down

the blackest

**BLACKS**

because it is saturated with **"black gold"** graphite

of more than 99% pure carbon.

**Nature at her best** produces "black gold" graphite for imported CASTELL. Because this natural graphite assays at more than 99% pure carbon, there is no need to add foreign sustances. CASTELL is *born* black.

**Our job** is to refine this superior graphite through our exclusive microlet-milling process—to reduce the granules to perfect cohesion and to encase the lead in the finest-grained cedar wood.

**Thus,** when you pick up a CASTELL in any of its 20 scientifically-uniform degrees, ranging from 8B to 10H, you are assured of clean, crisp, extremely opaque lines that will not flake or feather even after hundreds of trips through the blueprint machine. There's no need to constantly brush away graphite dust. CASTELL graphite is close-textured and non-crumbling, reducing stains and smudges to a minimum.

**You owe it** to your career to use CASTELL, the Drawing Pencil of the Masters. All good dealers carry famous CASTELL. Why not call *yours* today.

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# Du Pont Announces

## A new synthetic rubber unequalled fuels, solvents and chemicals at

The addition of VITON to the Du Pont family of elastomers (neoprene and HYPALON®) corresponds to the increased need for flexible construction materials with higher heat resistance.

The outstanding property of VITON is its ability to withstand temperatures of 400° F. and up in contact with most oils, chemicals, solvents and fuels. In addition, VITON also has good mechanical properties plus excellent resistance to ozone, oxygen and weathering.

VITON resists temperatures up to 450° F. in continuous service and up to 600° F. in intermittent service. This kind of heat resistance, coupled with VITON'S resistance to most fluids at these temperatures, makes VITON serviceable where other commercial elastomers would fail rapidly.

VITON'S mechanical properties are good for any elastomer and excellent for one that is highly resistant to heat and fluids. Notable among these properties are low compression set and good tensile

### "VITON" RESISTS CORROSIVE FLUIDS

Data were obtained by immersing VITON vulcanizates for 7 days and measuring the effect on properties shown.

| | | Tensile Strength Retained % | Hardness Change Points | Volume Increase % |
|---|---|---|---|---|
| SOLVENTS | Carbon tetrachloride, 75° F. | 85 | +2 | 1.3 |
| | Ethyl alcohol, 75° F. | 97 | +2 | 1.7 |
| | Aniline, 75° F. | 100 | −1 | 3 |
| | Tricresyl phosphate, 300° F. | 93 | −11 | 24 |
| | Acetone, 75° F. | — | −11 | 271 |
| FUELS AND LUBRICANTS | JP-5 petroleum aircraft fuel, 75° F. | 100 | +1 | 0.4 |
| | Ref. fuel B (70 isooctane, 30 toluene), 75° F. | 93 | +1 | 2.5 |
| | ASTM No. 3 oil, 300° F. | 95 | −1 | 4.3 |
| | Turbo oil No. 15 diester lubricant (Mil-L-7808), 400° F. | 60 | −6 | 19.6 |
| HYDRAULIC FLUIDS | Transmission fluid, Type A, 212° F. | 77 | −1 | 1.5 |
| | Oronite 8200 silicate ester, 400° F. | 93 | 0 | 1.8 |
| | OS-45 silicate ester, 400° F. | 62 | −3 | 11.1 |
| | Skydrol 500 phosphate ester, 300° F. | — | −32 | 270 |
| ACIDS AND BASES | Sodium hydroxide, 46.5%, 75° F. | 75 | +1 | 2.1 |
| | Sulfuric acid, fuming, 75° F. | 58 | −4 | 4.8 |
| | Hydrofluoric acid, 48%, 75° F. | 98 | +2 | 4.8 |
| | Hydrochloric acid, 36.5%, 75° F. | 81 | −8 | 7.3 |
| | Nitric acid, red fuming, 75° F. (Special acid-resistant compound) | — | — | 16 |
| | Acetic acid, glacial, 75° F. | — | −10 | 61.6 |

# VITON

TRADEMARK

Synthetic rubber

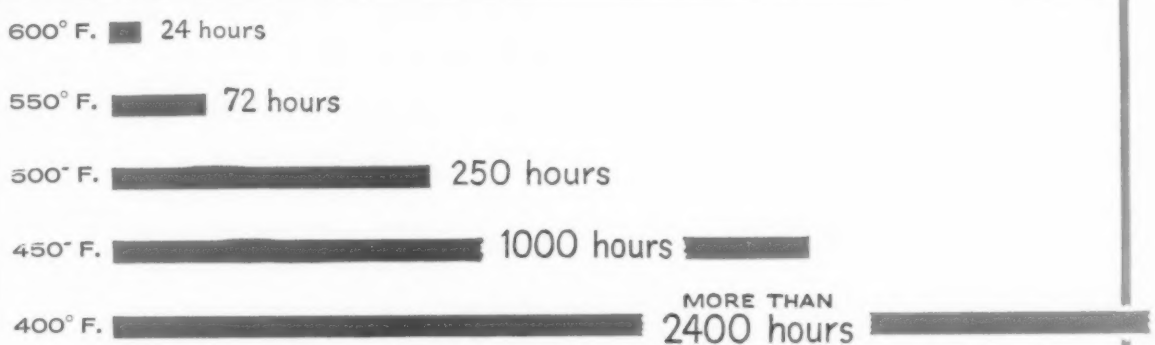
## for service in oils, temperatures over 400° F.

strength. VITON specimens compressed 25% and held 70 hours at 250° F. recover to within 90 to 97% of their original dimension—making them good seals at high temperatures. VITON, tested at room temperature, has a tensile strength in the range of 2000 to 3000 psi and ultimate elongation varies from 100 to 400%, depending on hardness. (Vulcanizates of VITON can be made in any hardness from 60 to 95 durometer.)

With VITON, it is possible to obtain high heat, fluid resistance in close tolerance components due to VITON'S easy processability. VITON is being put to use in precision seals, diaphragms, coated fabric, linings and other critical applications. If you have need for a flexible material highly resistant to both heat and corrosive fluid, ask your rubber supplier about VITON. For a free booklet describing VITON'S many useful properties write to E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. PE-7, Wilmington 98, Delaware.

In Canada: Du Pont Company of Canada (1956), Ltd., Box 660, Montreal

### "VITON" RESISTS HEAT

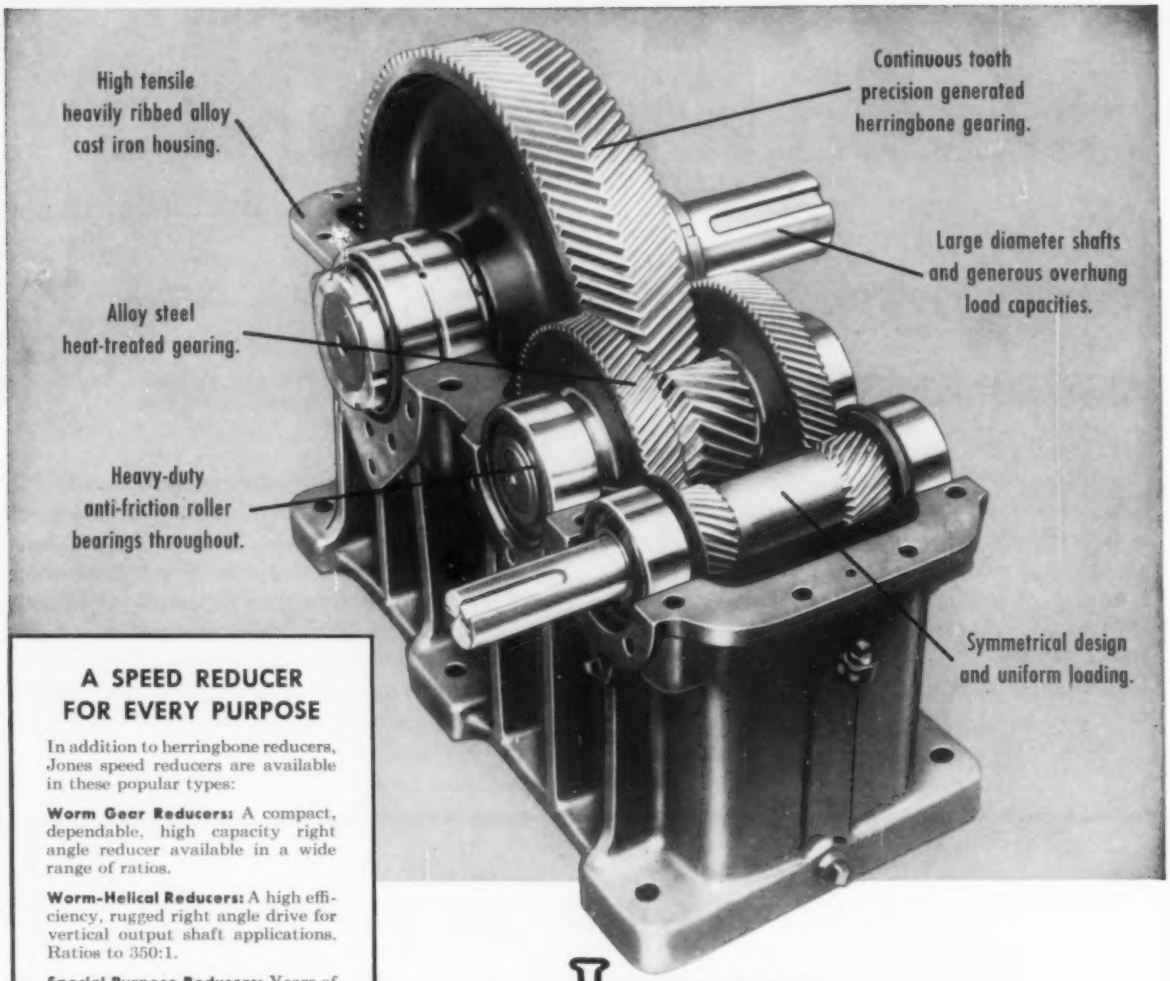



Periods of time for which VITON vulcanizates have remained usefully elastic when oven aged in air at the temperatures shown.

DU PONT VITON

REG. U. S. PAT. OFF.

**Better Things for Better Living . . . *through Chemistry***


High tensile heavily ribbed alloy cast iron housing.
Continuous tooth precision generated herringbone gearing.
Large diameter shafts and generous overhung load capacities.
Alloy steel heat-treated gearing.
Heavy-duty anti-friction roller bearings throughout.
Symmetrical design and uniform loading.

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In addition to herringbone reducers, Jones speed reducers are available in these popular types:

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**Worm-Helical Reducers:** A high efficiency, rugged right angle drive for vertical output shaft applications. Ratios to 350:1.

**Special Purpose Reducers:** Years of enclosed gear drive design and manufacturing experience at your service where special purpose reducers are required.

## ONLY Jones GIVES YOU ALL THESE QUALITY FEATURES IN THE EXACT SIZE FOR YOUR NEEDS

Here's why these design features enable Jones Herringbone Gear Speed Reducers to stand up to hard service in all industrial applications:

*Precision generated herringbone gearing* of rugged heat-treated alloy steels gives these reducers the toughness to carry heavier loads, provide smoother operation, and give longer service life in the most strenuous applications. *Anti-friction bearings*, conservatively selected, provide continuous accurate gear alignment and maximum efficiency at all speeds from start to full load. *High test alloy iron housings* mean rigid protection for gears and bearings and prevent damaging deflection or distortion. *Splash lubrication system* keeps a continuous supply of oil flowing to all rotating parts, insuring trouble-free duty. Shaft extensions and joints are effectively sealed to keep oil in and dirt out.

Balanced design and top quality features such as these spell out savings through low maintenance costs, efficient operation, and exceptionally long service life. Jones Herringbone Gear Speed Reducers are available in 57 standard sizes with mechanical capacities up to 1950 H.P. and a wide variety of ratios to permit economical selection of the proper unit for each application. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

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# *Engineer's Catechism*

What's "basic research", "industrial engineering"—or just plain "engineering"? Ask any two engineers (if you can decide what *they* are), and you'll get two opinions. And the longer they discuss it, the farther they'll differ.

The churches solved such problems long since with approved definitions and explanations called a catechism. There is thus an approved and official answer to most questions, and if you challenge you have the weight of centuries to combat.

But men of science (anyone who passed trigonometry in high school), extremely precise in technical terminology about *things*, are absurdly variable in terminology about *functions*. Let's start with "basic research." Charles E. Wilson explained it as "when you don't know what you're doing"—possibly expressing an automotive point of view. Somebody else said it is "concerned with the solution of problems to create new products and improvements." There's a sales-oriented definition if we ever heard one—it means that basic research must have a direction and a dollar sign, not just be concerned with finding the answer to someone's curiosity. It can't just be "unlocking the secrets of nature," because who would pay for it?

"Engineer" means anybody with an analytical turn of mind, anyone with experience in engineering, anyone with an appropriate degree from a recognized college, or anyone with a license, depending on where you sit. In some states, it can still be an engine driver. A year ago, we quoted a British definition, to whit: ". . . man with a rubberband mind." But that suggests a circus sideshow, or at least an extremely flexible definition. Ask if a "designer" is an engineer, and you have even Noah Webster confused.

Well, 130 years ago, Thomas Tredgold called engineering "the art of directing the great sources of power in nature for the use and convenience of man." Is it an art or a science? And is it solely concerned with the "great sources of power in nature?" Is it analysis, diagnosis, synthesis? Or is it some of all three, and more?

We've had endless discussions. We've printed some. Our guess is that they confuse rather than clarify. What of "director of engineering" and "technical director"? Are they bosses, technical men, or both? What is the chief engineer? Is the "vice-president-engineering" the big gun, or is there also a "vice-president-research", or some other title to split the authority?

You see where this is heading. We come inescapably back to the simple things, like the Connecticut Yankee's choice of a title when Arthur dubbed him knight. "Just call me Sir Boss", he said. Of course, a humorist wrote that line, but it is beautifully and inescapably clear. It's like "owner", "president", or "manager". All those titles have the ring of authority.

Perhaps some genius (humorous or otherwise) can come up with as straightforward definitions for some of the other basic words and phrases. For example:

"Science uncovers the secrets of nature."

"Engineering applies those secrets to the needs of man."

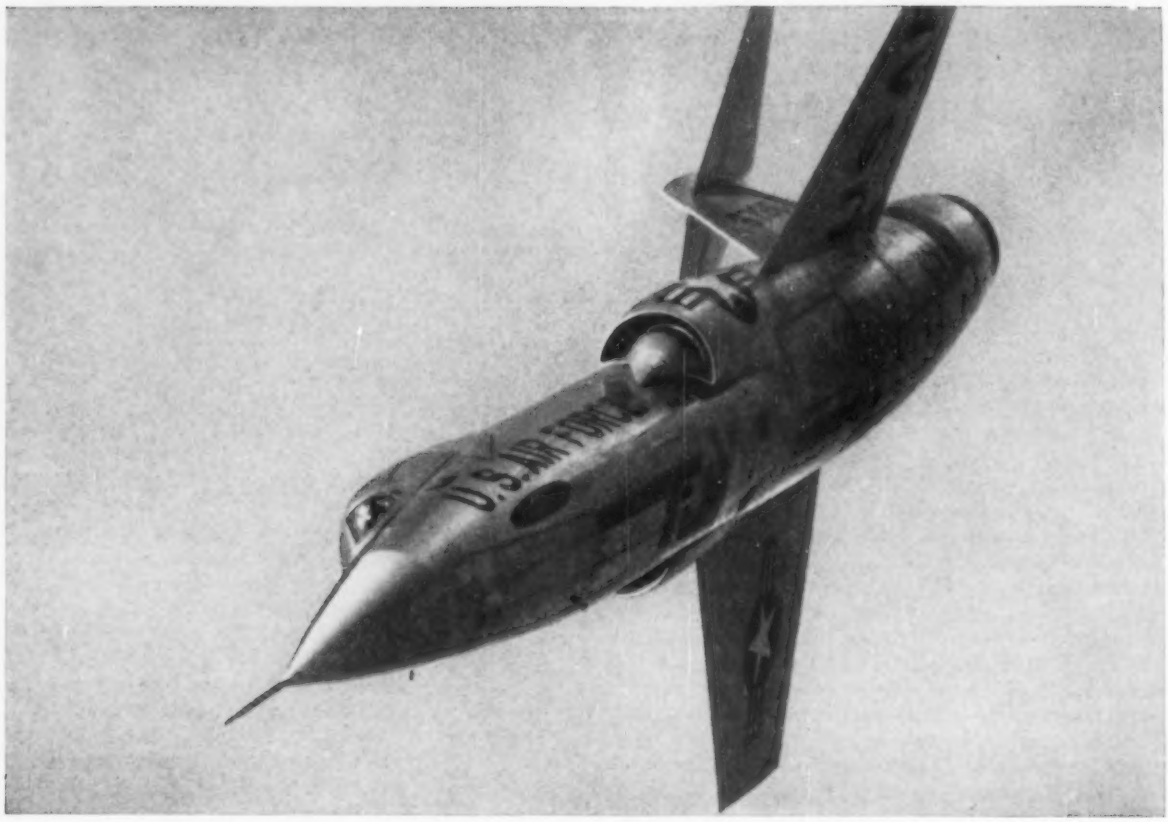
"The scientist is a trained mind that finds out why."

"The engineer is a trained mind that finds out how."

"Basic research is concerned with *why*, not when or where."

"Applied research is concerned with how, what, when and where."

These will never do; they're too simple. And they contain no Latin derivatives, no sonorous phrases, no weasel words. So we still need a catechism.




**Guided Missile with a Man in it.** Electrical power for the Lockheed F-104 Starfighter, one of the world's fastest interceptors, is furnished by a 24-volt sintered-plate, nickel-cadmium battery developed by Sonotone Corporation, Elmsford, N. Y.

# World's fastest jets meet deadly challenge

**In an ultrasonic plane,** the pilot can't stop to worry about *flameout* – jet engine stalling.

When electrical energy is needed to restart his dead engine, the plane's battery must be ready to deliver.

And that's just what the one in this jet does. For it's the new sintered-plate, nickel-cadmium battery developed by Sonotone Corporation, and standard in every F-104.

Here's a 10-pound mite that surges with power under all conditions. In cold down to 65° below zero, or heat up to 165° above . . . even when the plane is flying upside down!

**The secret** of its dependability lies in radically different construction. Powdered nickel sintered onto nickel mesh produces a porous structure that multiplies the active "working" area more than 200 times! That's why the battery can deliver enormous surges of power without fail.

The use of Nickel in Sonotone's sintered-plate, nickel-cadmium battery is another example of the important part Nickel – plus imagination – plays in solving a wide range of product problems.

**Do you have a metal problem?** One that involves high or low temperatures . . . corrosion . . . stress . . . fatigue . . . or some other complicating factor? Talk it over with us. We may be able to help you find out how Nickel or a Nickel Alloy can keep *you* off the ground.

**Despite its small size** and light weight, this sintered-plate, nickel-cadmium battery – only one-quarter the weight of a conventional battery – can be depended on to provide reliable electrical power under adverse flight conditions.

**THE INTERNATIONAL NICKEL COMPANY, INC.**
67 Wall Street INCO New York 5, N. Y.

# INCO NICKEL

## NICKEL ALLOYS PERFORM BETTER LONGER

# Carmakers Seek Answer to High Tool Cost

**Tempo of design increases tooling cost per car; industry plans wider use of building-block elements in standard and special machine tools.**

DETROIT—Economically, the annual automotive changeover is expensive and represents a fairly important slice of automobile cost. But it also serves to keep the engineers here on their toes, fostering mechanical advances, ingenuity of design, safety and comfort. It is responsible for the extensive styling studios, market-research organizations, research and development programs in materials, manufacturing processes and advance engineering. And—a big point—it is responsible for a continuing change in the philosophy and the design of the machine tools that make the cars.

Though car makers realize that the annual change-over to create new models represents a major expense item, there hasn't been the slightest hint that retooling programs will be abandoned. This attitude prevails in the face of spiraling change-over costs.

Not only have rising costs contributed to change-over expense. The tempo of re-design has also increased. Introduction of new engines, extensive annual body changes, development and application of new materials occur at an ever-increasing rate.

Take engines, for instance. Between 1932 and 1953 the Ford car used the same basic engine, the L-head V8. It was replaced by an overhead valve engine which lasted only four years for the highest volume models. A new engine appeared in the '58 line. The rate of new engine developments in the industry indicates that we will no longer see manufacturers use the same engine for a number of years.

Development of new materials also is a continuing process. The Research Dept of General Motors, for example, is in almost constant collaboration with the Central Foundry Div to find new, better casting alloys particularly suited to automotive design. Similarly, in future cars there will be increased use of aluminum, plastics and stainless steel.

### MACHINE TOOLING CYCLE

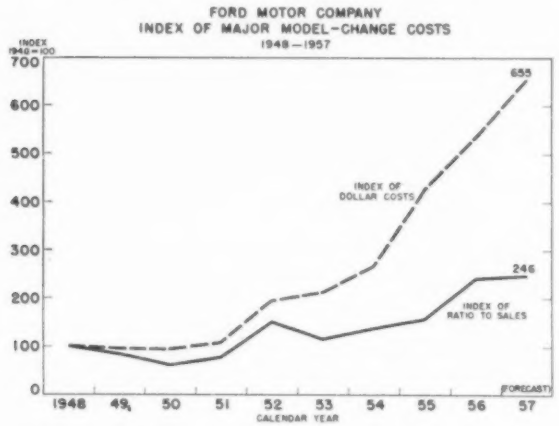
Originally, auto plants were oversized machine shops equipped with standard machine tools. Then, to reduce cost of production, standard machine tools were replaced by specially built machining "lines" with emphasis on automatic production and transfer —movement of the part from one machining operation to the next. The process is not completed by any means, so that if certain operations can be performed more economically by the introduction of a specially designed machine or line, the change can take place at any time, even in the course of a production model.

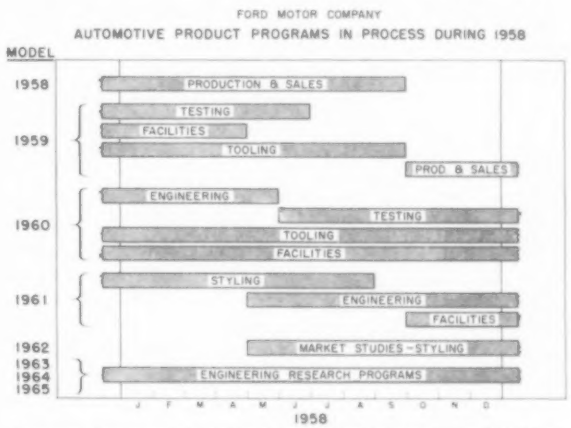
Such replacement or upgrading takes place in US auto plants all the time, providing economics of the situation warrant it. As a general rule, savings must amortize cost of the new shipment within three years. In the past, the decision to order such specialized machine lines wasn't hard to make. Long lead times gave the engineers considerable leeway. But more recently there's been a concerted effort to reduce lead time.

At Ford, engineering for the 1960 model has only just been completed, leaving little more than two years' assured life for a cost-reduction replacement line. With minor variations the same holds true in the other companies. As a result, not only is the decision to order the specialized lines harder to make, but occasionally it is then cancelled. Also, there has been the desire to be able to make changes at any time before a model goes into production, to improve quality or meet competition.

### TOOLING SALVAGE NEGLIGIBLE

But while special machining lines provided high productivity and lower part costs, flexibility was sacrificed. Thus, changeover meant scrapping the




**Auto model change-over . . .**
is expensive. Chart at left shows increase during past 10 years in Ford's special tool amortization, engineering and styling costs. Top line shows index of changes in dollar expenditures with 1948 as a base with 1957 6½ times the base. Lower line provides an index of Ford's annual dollar sales (excluding defense sales) showing an increase more than twice the 1948 expenditure. Chart at right depicts lengthy lead times provided for various phases of car manufacture by Ford. Note that engineering research programs are already underway for 1965 models.

old line, replacing it with a new line. Salvage was negligible in terms of total cost—little more than the power units and the pump-and-tank units could be saved.

According to Ford, its total 1955-model tool expenditure was broken down as follows: 72% for body and front-end tooling, 12% for chassis tooling, 16% for engine tooling. Three years later, all of the body, front end and chassis components were changed to such an extent that tools purchased for the 1955 model could not be used to produce 1958-model parts. Only one-fifth of the engine tooling used on the 1955 model is still in use on the 1958 line.

Three years ago Ford started advocating the building-block concept for all standard machine tools as well as for in-line transfer machines. The building-block concept itself is not new; some machine tools have been built to modified standards in the past, but applicable only to a particular car maker's product.

The next step forward was taken this year. A committee of industry representatives was formed to conduct conferences with builders of special machine tools—to interest them in helping establish industry-wide standards. (*PE*—Apr. 21, '58, p 24).

According to Ford's H. C. Daum, who has spearheaded the move, the new concept will not influence the mechanical design of the special lines the machine builders produce, nor will it limit the ingenuity of design engineers. Rather, it means building new machines in sections that can be repositioned, replaced or separated so that additional sections may be added. Each section will contain one or two stations (involving one or two operations per station) with all stations connected by transfer mechanisms.

#### SMALL-CAR TOOLING

Next-door to the solving of high retooling costs is the matter of the small economy car. While the Big Three of the auto industry remain tight-lipped, reports that GM and Ford will produce a small car have been widely circulated.

There is a common misconception that tooling for a small car is inexpensive per se. Automotive tooling men, however, point out there is little saving if the car is simply a smaller version of its bigger brothers—the same number of tools are required, involving the same amount of labor to produce them. Only the size of the tools would represent a saving—in terms of materials. But tooling costs for such optionals as automatic transmission, heater, defroster, radio, etc., would be just as expensive; costs that most foreign economy car makers can avoid because their buying public doesn't demand such accessories. But here in the US, such "optionals" have come to be considered almost essentials; at least, US carmakers are convinced of this.

Operational savings in a small car will result from lower horsepower ratings, 60 and 100 being the most likely. Some power savings are made possible by the reduction in the number of power accessories, and some may be made at the expense of acceleration. But the most important source of power saving will be in the car weight.

Just how this weight saving will be achieved is a subject of speculation. Smaller over-all size is one point where weight will be saved, but the recent announcement that GM has produced and tested motors with aluminum blocks is an indication of things to come. This motor could be placed in the rear, eliminating the hump in the floor that robs so much floor space in the current models. Aluminum's high thermal conductivity could mean an air-cooled motor, which would eliminate the weight of the coolant and the circulating pump. Opposed-piston design would permit adequate flow of cooling air over the motor. These, in turn, make possible other weight savings, which permit lighter suspensions and lighter frames. The savings accumulate.

## Double Copper Bath Improves Chrome Plate

DETROIT—Chrome plate with superior resistance to corrosion is claimed by the Pontiac Div. of General Motors. The plate is produced by applying a copper bath to the base material, buffing the copper, then applying a second copper bath. Ordinarily a single copper layer underlies Pontiac's chrome finishes.

Parts plated by the new technique withstand salt spray tests for 24 hr, say company sources. They also point out that salt sprayed on city streets for snow removal in many parts of the country is a main cause of auto-part corrosion. Standard parts withstand salt spray tests for 18 hr.

T. F. Doyle, superintendent of Pontiac's plating plant, explains that the first copper bath and buffing eliminate microscopic irregularities on the surface of the base material and provide a smooth backing for subsequent chrome and nickel plates. Base material irregularities, he says, are accentuated by the first copper bath. Buffing at this point removes them and closes pores of the copper deposit.

The five steps in the new process are: a 0.001-in. semi-bright copper deposit; buffing to reduce copper layer to 0.0008 in.; a 0.001-in. bright copper deposit; a 0.008-in. nickel deposit; and a 0.00005-in. chrome deposit.

## Detroit P.O. to Get First Automatic Mail Sorter

DETROIT, MICH.—Burroughs Corp. here received a $1.2-million contract to build and install 10 mail-sorting machines from the design concepts of the National Bureau of Standards and the Rabinow Engineering Co., Takoma Park, Md. (PE—May 12, '58, p. 22). The first unit is scheduled for installation in Detroit in Aug., 1959.

With 12 keyboards, the machines to be built by Burroughs will sort 3,000 letters per hour per keyboaord to 300 different destinations. The machines will be 74 ft long, 15 ft wide and 11 ft high.

Two semi-automatic mail sorting machines are already in test use. One is a Dutch-built machine called the Transorina, which was installed in the Silver Spring, Md., post office in May, 1957. The other, Belgian-made, was installed in the Washington, DC, post office in May of this year.

STAMFORD, CONN.—More R & D work on automatic letter-sorting machines is indicated by a $1.5-million contract from the Post Office Dept. to Pitney-Bowes, Inc., Stamford, Conn.

Pitney-Bowes will design, develop and produce the prototypes of mail-sorting devices which will coordinate single, modular letter-sorting machine units into groups for handling large quantities of mail. Coded addressing methods will also be investigated.

# Bits and Pieces

**Creep resistance of nickel-copper alloys** is superior to that of the parent metals, according to tests made at the National Bureau of Standards of high-purity nickel and copper and two nickel copper alloys. Tests made in tension at high temperatures also show that the rate of strain-hardening and degree of strain-aging are increased by alloying nickel and copper. . . .

**Improved alloys for rotor bearings** in aircraft gas turbines were developed by Horizons, Inc. for WADC. All except one of these alloys reported to have better bearing porperties than "S" Monel and iron-silicon bronze, had silver as the major alloying element. Adding 2-4% silicon improved wear properties. Alloy composition can be varied considerably with respect to the load-supporting phase if silver is in the soft matrix. . . . A peak braking force of 632,000 lb. was reached in stopping a 6,950 lb. test sled traveling 940 mph at the Hurricane Supersonic Research Site, Utah. Using a vertical return water scoop, an average deceleration of over 80 g's was maintained for 300 ft, with a peak of 91 g's recorded. . . .

**The turnover in cutting tool designs** for machining uranium compounds will be 72% greater than those used for machining conventional metals according to the Super Tool Co., Detroit 13, Mich. Design life of carbide cutting tools may be as short as 90 days to keep pace with nuclear material changes from month to month. . . . Dr. Renato Contini, senior research scientist at New York University, has been elected president of a new national society known as The Human Factors Society of America, Inc. Purpose of the society is to "increase and diffuse knowledge of man in relation to machines and promote its application in design, manufacture and use of systems and devices. . . . Speaking to the members of the Polish Astronautical Society, a Russian scientist said that their preparations were now complete for launching a missile to the moon. He said that several attempts had already been made without success.

**Single-stage compressor gas turbine . . .** believed to be the first developed in the US is shown shortly before its maiden test at Boeing Airplane Co.'s Industrial Products Div. Known as the T60, the 400-hp engine is being developed for potential use as a helicopter power plant by Boeing for the US Navy Bureau of Aeronautics. Boeing says the 320-lb T60 operates at the highest pressure ratio ever achieved in a single-stage compressor engine sometimes going as high as 6.14-1. The turbine is designed for pressure ratio of 6:1 on a 60F day. The compressor section is driven by a single-stage radial flow turbine wheel, variable inlet geometry being employed to guide the flow of incoming air. The device is said to give efficient operation over the full pressure ratio range from idle to maximum output at takeoff. The T60, an outgrowth of the Boeing 502 series of gas turbine engines, will undergo an intensive development program leading to a 50-hr preliminary flight rating test.

## Expert Questions Federal Scholarships

WASHINGTON—"What is the purpose of the Federal scholarship program? Is it to make a college education available for capable youth who cannot attend college? If so, then it will fail, for it will have as a main effect the concentration of able students in a relatively few of our more expensive colleges. High tuition colleges will raise their tuitions higher. It will discourage state and private scholarship programs."

This was a statement made by John M. Stalnaker, president of the National Merit Scholarship Corp., Evanston, Ill.,—speaking for himself, not the corporation—as he appeared before a House subcommittee on Education and Labor, conducting hearings on proposed federal educational programs.

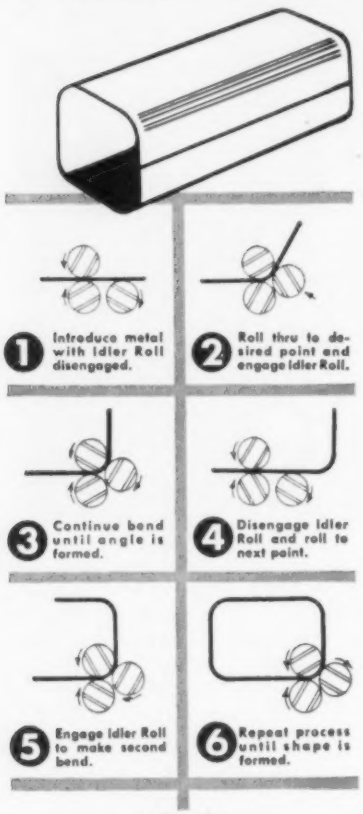
Already the records of the Senate and House hearings on the subject run to a total of 3,671 pages. A federal undergraduate scholarship is expected to be one of a series of recommendations made to Congress.

Mr. Stalnaker continued, "Scholarship programs are frequently intended to remedy the loss of talent, to encourage and make it possible for able students to go to college. But, if we select, state by state, the best 10,000 students by the usual techniques, how many will not already be college bound?

"In the National Merit Scholarship Program last year, we identified some 15,000 students. Since then we have checked samples of these students to determine how many are not in college. Of the top 7,500 students, drawn from each state in proportion to population (just as both bills propose), we find about 97% in college. Of the next 7,500, 95% are in college.

"Thus without a Federal scholarship program, most of these students are going to college—well over 90%. Of those not going, only a fraction can be hoped to be changed by a Federal scholarship program.

## HOW TO FORM a rectangular shape


1 Introduce metal with Idler Roll disengaged.
2 Roll thru to desired point and engage Idler Roll.
3 Continue bend until angle is formed.
4 Disengage Idler Roll and roll to next point.
5 Engage Idler Roll to make second bend.
6 Repeat process until shape is formed.

with the

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# Measurement Methods Retard US Design Progress

WASHINGTON—Important laboratory and field experiments are needed in a number of fields in which we must make rapid progress in design. But the experiments are being held up by unsolved instrumentation and measurement problems. So says the American best informed about the over-all situation—Dr. Allen V. Astin, Director of the National Bureau of Standards.

Lack of sufficient know-how is making it difficult for his Bureau to comply with requests for measurement and calibration services, says Dr. Astin. Surveying the fields that give requests the NBS finds itself unable to answer yet, he lists: high-temperature, high-pressure, direct-force measurement, electronic measurement devices for ultrahigh and microwave frequencies.

Other technological areas which he feels deserve the attention of the instrument sciences are: reliability, miniaturization, training and educating of scientists for instrumentation.

### WHERE WE'RE LACKING

In the high-temperature area, Dr. Astin believes we lack standards, instruments, measurement techniques, and materials data which better instruments would make possible. He said that above 1000 C very little usable data are available. At 2000 C and 3000 C there is a more serious lack, and beyond exists an almost complete void. At NBS, high-temperature calibrations are made to 2800 C and are certified to an accuracy of 8°. On a limited basis such readings can be extrapolated to 4000 C.

Dr. Astin added that Russia has announced its national standardizing organization has claimed an ability to make regular calibration of temperature-measuring devices up to 6000 C, and that by 1960 this service should be increased to 12,000 C.

The field of high-pressure research is expanding, as is the industrial use of high pressures in product synthesis, said Dr. Astin. Super-pressure will ultimately yield new forms of matter of scientific and industrial interest. Despite improvements in pressure-measuring and pressure-producing devices, he cited the need for specific attention to high-pressure instrumentation—in both its mechanical and electrical aspects.

The field of direct-force measurement concerns missile propulsion systems. Devices used to develop accurately controlled thrust in ballistic flight depend directly upon effectiveness of calibration services. Dr. Astin pointed to the present demand for calibrations which will provide a certification of a one-million lb. device to one-tenth of 1%. Such accuracies cannot be given now, but NBS is developing plans for providing direct measurement of load-cell systems up to one million lb.

Concerning electronic measurement devices for ultrahigh and microwave frequencies, Dr. Astin said, "Again we have arrived at the edge of new developments only to find ourselves held back by inadequate measurement standards, techniques and instrumentation." A new electronics calibration center will be opened soon at NBS' Boulder Laboratories in Colorado.

On reliability: "If we don't develop a rational basis for evaluating this interdependency (of interdependent components in the system) we may restrict the future of instrumentation."

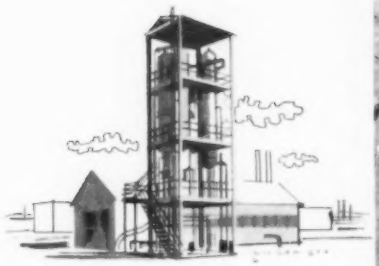
# First Organic Moderator for German Reactors

BONN—A 20:1 scale model nuclear reactor that uses an organic fluid (terphenyl) as a coolant and heat transfer agent was exhibited by Interatom at the recent German Chemical Show here. A full-size version of the exhibited model is said to obtain live-steam temperatures up to 550 F in the primary loop at comparatively low pressure.

The full-scale plant generates steam at the rate of 1,370,000 lb/hr; steam is fed into a turbine at 100-mw electrical output.

Organic-moderated reactors are of interest because they produce fairly high steam temperatures at moderate reactor pressures and by-pass some of the corrosion problems encountered with other types. One is already in operation here.

**Pilot plant reactor shell** *after 2000 hours service. Note corrosion on stainless steel shell and flange, while titanium liner shows no corrosion effects. Right: Titanium dip-tube after 2000 hours operation remains free of corrosion damage.*



*In high-temperature nitric acid service...*

# TITANIUM WINS TOUGH 2000-HOUR CORROSION TEST

A large petrochemical company recently tested titanium versus other metals in high-temperature nitric acid service. 6% to 10% concentrations were handled in a pilot plant reactor at temperatures between 300° to 400°F.

Above you see dramatic proof of titanium's performance in this punishing service. After 2000 hours, the reactor's titanium liner and dip-tube showed no corrosion effects, while the stainless steel shell and flanges were badly corroded.

Further corrosion-rate tests were made by immersing test coupons of various metals in the reactor for 40 hours. Again, test results proved titanium's outstanding corrosion resistance (see chart at right).

Want more information? Write for bulletin on Corrosion Resistant Properties of Titanium.

**CORROSION RATE TEST**
*Conditions: 375° F, 300 psig, 6% nitric acid*

| Material | Corrosion Rate mils/yr |
|---|---|
| Titanium | nil |
| 347 stainless steel | 59 |
| 304 stainless steel | 170 |
| 310 stainless steel | 274 |
| 410 stainless steel | 402 |
| 309 stainless steel | 485 |
| Nickel-Chrome Alloy | 20,500 |

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## Franco-German R&D Institute Nears Reality

BONN—The German cabinet has approved a German-French agreement on joint maintenance of a ballistic research institute located in St. Louis, France.

The agreement provides a contractual basis for future cooperation of the two countries at this institute in which a number of German scientists have been working since 1945.

The agreement, negotiated to its final stages over a period of four years, was in fact signed by the defense ministers of the two nations last March 31 in St. Louis. Final parliamentary approval is still required.

The institute will carry out basic research, theoretical and experimental, in the following fields: high-frequency cinematography, detonation theory, hollow-charges for anti-tank defense, computation or ballistic curves, and computation of muzzle velocity. Research will not comprise nuclear weapons.

Under the agreement, Germany will contribute $1.66 million for modernization and expansion of the institute as an equivalent of investments made by France so far. In the future, each country will contribute $1.2 million per year for upkeep.

The institute staff numbers 100 scientific and 250 administrative personnel. Administration is in French hands while the scientific department is headed by Professor Hubert Schardin, formerly director of the Ballistic Institute of the Luftwaffe Academy in Berlin-Gatow. Majority of German scientists in the St. Louis institute were recruited from this academy.

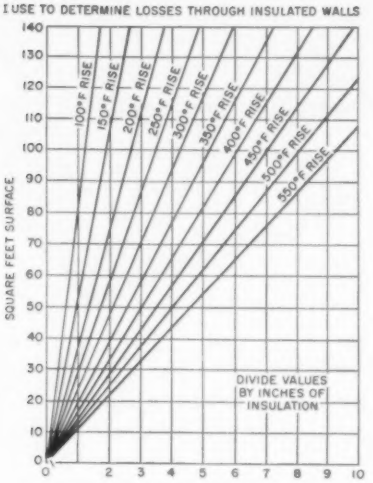
## SRI to Keep A-papers

MENLO PARK, CALIF.—The US Atomic Energy Commission has contracted with Stanford Research Institute here to maintain a classified-documents depository to serve the western states. The initial collection at SRI contains 7,000 reports dealing with various aspects of nuclear-energy research.

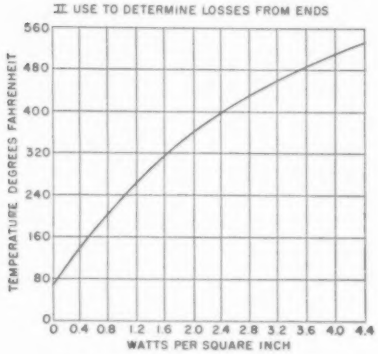
Scientists and engineers from firms holding AEC access permits can use the depository by making arrangements with the San Francisco Operations Office of the AEC in Oakland, Calif. An AEC unclassified depository has been in operation at SRI since 1954.

# How to choose the right amount of heat for ovens and process air applications

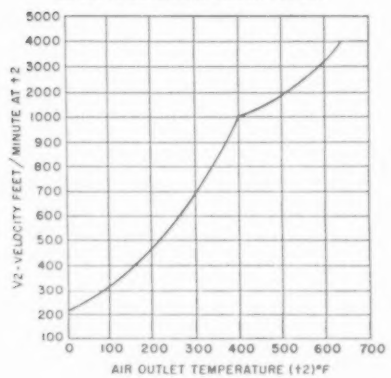
I USE TO DETERMINE LOSSES THROUGH INSULATED WALLS




II USE TO DETERMINE LOSSES FROM ENDS




III USE TO DETERMINE VELOCITY OF AIR



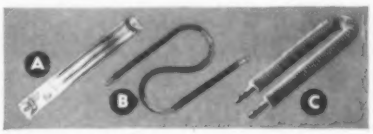

**IV This Table Lists Specific Heats**

| Substance | Average Specific Heat | Weight in Lb per Cu Ft |
|---|---|---|
| SOLIDS | | |
| Aluminum | 0.23 | 160 |
| Antimony | .052 | 423 |
| Asphalt | .40 | 65 |
| Beeswax | ... | 60 |
| Bismuth | .031 | 610 |
| Brass | .10 | 525 |
| Brickwork and Masonry | .220 | 140 |
| Carbon | .204 | ... |
| Copper | .10 | 550 |
| Glass | .20 | 165 |
| Graphite | .20 | 130 |
| Iron, cast | .13 | 450 |
| Iron, wrought | .12 | 480 |
| Lead, solid | .031 | 710 |
| Lead, melted | .04 | ... |
| Nickel | .11 | 550 |
| Paper | .45 | 58 |
| Paraffin | .70 | 56 |
| Pitch, hard | ... | 83 |
| Rubber | .40 | 95 ± |
| Silver | .057 | 655 |
| Solder (50% lead—50% tin) | .04 | 580 |
| Steel | .12 | 490 |
| Sugar | .30 | 105 |
| Sulphur | .203 | 125 |
| Tallow | ... | 60 |
| Tin, solid | .056 | 455 |
| Tin, melted | .064 | ... |
| Type metal (85% lead—15% antimony) | .040 | 670 |
| Wood | .45 ± | 34 pine<br>50 oak |
| Zinc | .095 | 445 |
| LIQUIDS | | |
| Acetic acid | 0.472 | 66 |
| Alcohol | .65 | 55 |
| Benzine | .45 | 56 |
| Ether | .503 | 46 |
| Glue (mixed 2 parts water, 1 part dry glue) | .895 | 69 |
| Glycerine | .58 | 79 |
| Mercury | .0333 | 845 |
| Oil, cottonseed | .47 | 60 |
| Oil, machine | .40 | 58 |
| Oil, olive | .471 | 58 |
| Paraffin, melted | .71 | 56 |
| Petroleum | .51 | 56 |
| Sulphur, melted | .234 | ... |
| Turpentine | .41 | 54 |
| Water | 1.0 | 62.5 |

| | At Constant Pressure | At 70 F Atmospheric Pressure |
|---|---|---|
| GASES | | |
| Acetylene | 0.35 | 0.073 |
| Air | .237 | .080 |
| Alcohol | .453 | ... |
| Ammonia | .520 | .048 |
| Carbon dioxide | .203 | .123 |
| Carbon monoxide | .243 | .078 |
| Chlorine | .125 | .20 |
| Hydrochloric acid | .195 | .102 |
| Hydrogen | 3.41 | .0056 |
| Methane | .60 | .0447 |
| Nitrogen | .245 | .078 |
| Oxygen | .218 | .09 |
| Sulphur dioxide | .155 | .179 |

**Here is condensed information to help you get the most economical electric heaters for your oven and process air design problems.**

Generally, strip heaters (a) or tubular heaters (b) are used for natural convection applications. For forced convection heating, fin-tubular heaters (c) are most desirable.




Here's how you figure the amount of heat required:

1. Using the formula, lbs of material × specific ht × temp rise (F) over 3412 = kwh required, figure heat requirements for the conveyor.
2. Using the above formula, figure heat requirements for the material to be heat treated.
3. Figure total area, in square feet, of top, bottom and both sides of the oven. Check Table I to find total kwh losses. Adjust for insulation.
4. Figure area of both end openings in square inches. Multiply times factor found in Table II.
5. Figure in square feet, the area of the duct. Check Table I for losses. Adjust for insulation.
6. Figure cubic feet of volume of oven and duct. Find weight of air at room temperature from Table IV. Multiply your answer times total cubic feet times number of air changes needed per hour. With this answer, use formula from Step 1 above to find kw needed for air change losses.

Total the answer arrived at in the 6 steps above. Add 3 kw as a safety factor. You now know how much heat is required. For more complete information, send coupon below or call your nearest General Electric Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y.

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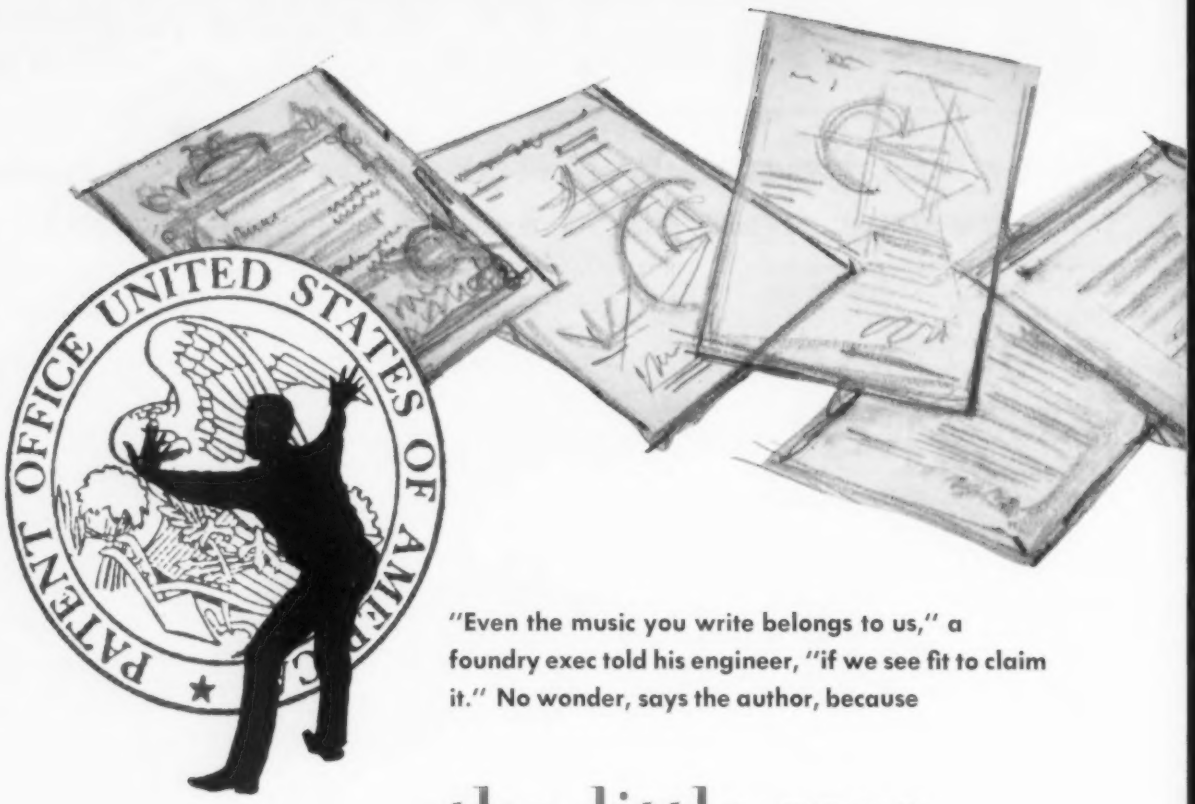
GENERAL ELECTRIC




**"Even the music you write belongs to us," a foundry exec told his engineer, "if we see fit to claim it." No wonder, says the author, because**

# the little man can't protect his patents

DAVIDLEE VON LUDWIG, *Consulting Engineer*

Even in our age of conformity, it's silly to say that different or original ideas can no longer be expected from individuals. This is not the case and never will be. Instead, our country's problem is to give our engineers and would-be inventors the incentive to create.

What incentive do they find under the present American patent system? Even if they do hatch an original idea, even if they can get financial backing, even if they develop and patent their invention, they have no protection.

For patents are only *civil* priorities–worthless paper unless the inventor can afford lawsuits to protect his rights–fictitious rights if he's financially unable to combat a major corporation.

The large corporations–almost without exception–deny any form of royalties to their employes. And they make it hard, almost impossible, for an individual to develop an invention himself, because they control most of the investment capital for research and development.

I know. In 1939-40, I offered a new carburetor to the Air Force and the National Advisory Committee on Aeronautics. NACA favored the invention, called it "the only new approach to aeronautical carburetion" they had ever seen, and recommended it as "worthy of development."

But the Air Force wouldn't finance development of inventions in the hands of individuals, so they suggested I take a job with an established aircraft producer.

### A lifetime job

Well, I tried. An aircraft engine manufacturer offered me "a lifetime job" but refused any royalty benefit as being "contrary to company policy"–and this position

**MEET THE AUTHOR**

Davidlee Von Ludwig's family settled in Strasburg, Virginia, 62 years before the US Government issued its first patent. Mr. Von Ludwig, who thinks the US *still* doesn't have a good patent law, is now a New York resident. He did his graduate work in physics at Columbia.

In over 20 years of design engineering, he's worked for Wright and Sperry, is now a consulting engineer with more than 350 patent disclosures in such varied fields as metallurgy, aeronautics, and electronics.

was typical of every major firm I approached through the last 19 years.

Next, my financial backer decided to file patents. But an outstanding patent attorney—a former Attorney General—told him: "Unless you can afford to invest at least $100,000 in litigation to protect your patent rights, I advise you as a friend not to file for patents." Why? Because: "If the interests of any major corporation become involved, unless you can sell your rights before patents issue, you will **never** succeed in selling them."

Or take the case of another invention. It was good enough to warrant security restrictions on its applications, but the vice-president of a major steel company told me I could either accept a job—without royalty benefits for my work—or get nothing. "You don't have enough money to sue us—so we'll just take your ideas and develop them without you," the exec told me.

### It's different in Germany

This sort of economic injustice is not worldwide: In Germany, law makes patents *personal property* which the government defends from theft or infringement. Even if a German inventor is a paid, full-time employe of a corporation, even if he's hired and supported to solve a specific problem, he must be paid royalties if his solution results in a patent for his employer. In fact, he must be paid royalties for *any* of his ideas patented by his employer or his employer's licensees.

This is a far cry from the system which American engineers and inventors are forced to accept. After all, a man is not a cow, to be given a lifetime job and milked of his brain power. Yet in the US, anything an employe does can be, and usually is, claimed by the employer. As a foundry president told one of his engineers, "Even the music you write belongs to us if we see fit to claim it."

Certainly few inventors create solely for monetary gain. Of all levels of mankind, the creative man is least interested in security—the status quo; his entire attitude is one of rejecting the norm, refusing to accept past accomplishment as final.

But without economic support, his ability to create is restricted; with an income and freedom to think, he'll contribute to many fields.

Industry doesn't see it that way: Industry wants to confine the inventor, to channel him down narrow—and profitable—avenues of thought; to classify him in a single job bracket.

It can't be done; it's impossible to catalog an inventor. Free-thinking and creative minds are by their nature uninhibited and disorganized. In fact, the disorganization is almost a precondition to creative thinking; new combinations of ideas arise almost at random from the hodgepodge in the creative mind.

And just as they can't catalog an inventor, neither can industry reduce originality to a formula. "Brainstorming" and "serendipity" won't bring the answers to our ballistic missile metallurgical problems any faster than the old suggestion box did, because neither stimulates *basic* inventive thinking.

Unfortunately, most of the creative thinking in industry today is foreign, not native, in origin. We have benefited from a postwar flood of creative scientists and engineers—men stimulated by a foreign environment.

But now, we can't afford to wait for another war to bring us more talent from abroad. We must tap *our own* reservoir of creativity—and the way to do it is to give our own scientists the economic support and incentive to create.

How? The first step is a totally new patent law. The government must grant patents that are properties, not just potential rights before a civil magistrate. And the Attorney General's office must *protect* those rights.

Then, the inventor can depend on receiving some income from his past inventions—as well as an incentive for further creativity. As a nation, we could thus become scientifically self-supporting—and free ourselves from having to hope for another flood of scientific brainpower from abroad. ■

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# *the Government says this on* OVERTIME PAY *for Engineers*

**Do you sometimes work late evenings, or go back to the plant on weekends? Unless it exempts you, the law requires extra pay for those extra hours. Here are the rules, simplified.**

**ROBLEY D. STEVENS** *Management Consultant*

Most engineers do not wish to be paid for overtime work. They would rather have the freedom and status associated with a salaried employe and to be classed as a professional–most of them are.

Your title may be "design engineer" but simply being classified as such is not enough to lift you out of the overtime crowd. It's the type of work you do, rather than the title, that counts.

The Fair Labor Standards Act requires that, except for certain exempt personnel, members of an engineering organization must be paid overtime for work exceeding 40 hours if the company is engaged in interstate commerce. This also includes occupations closely related or directly essential to such production.

The question becomes: Who, exactly, is exempt and who is not?

The regulations define three types of engineers who need not be paid for work in excess of the 40-hour limit. To be exempt you must meet all qualifying conditions.

### Who is exempt

You are outside the overtime requirements if you are:

• **An Executive Engineer** whose primary duty is management of the company or a department, and who (a) regularly directs the work of at least two full-time employes, (b) hires or fires, or recommends hiring or firing, (c) devotes no more than 20% of his workweek to nonexempt work, and (d) earns at least $55 a week.

• **An Administrative Engineer** whose primary duty is responsible office work or nonmanual field work of substantial importance in managing or operating the business and who (a) customarily exercises discretion and independent decisions, (b) devotes no more than 20% of his workweek to non-exempt work, and (c) earns at least $75 a week.

• **A Professional Engineer** (not to be confused with *registered* professional engineer) who (a) consistently exercises discretion and judgment, (b) does work that is primarily intellectual and varied, as distinguished from routine, mechanical duties, (c) devotes no more than 20% of his workweek to non-exempt work and (d) earns at least $75 a week.

### Who is not

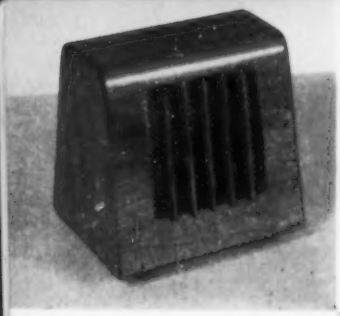
The mere possession of an engineering degree does not qualify you for classification as a professional engineer. Further, wage-hour regulations do not exempt all employes of professional employers, or all employes in industries having a large number of professional workers. Nor do they exempt persons who are not professional engineers but are simply trainees, junior engineers, draftsmen or others carrying the title of "engineer" but not actually performing the duties of a professional. All these must be paid for overtime. The clause limiting nonexempt work to 20% of the workweek distinguishes between the bona fide professional and the working engineer who spends most of his time with work only remotely related to supervisory activities.

Your employer, no matter who he is, is required by law to keep certain time and pay records. These must be opened for official inspection upon request. He will usually keep the records for two years from date of last entry. They will include all worksheets from which wage-hour computations are made, such as time cards, wage-rate tables, worktime schedules, billing orders and shipping records. In addition, your employer must have available for inspection, personal information about you as an employe–including full name, home address, social security number, occupation, hour and day your workweek begins, total hours worked weekly, basis on which your wages are paid, legal deductions from wages, total wages paid each pay period, and date of payment.

### Employers liable

If a government inspector finds that officially nonexempt employes are not being paid for overtime as required by law, the employer may find himself subject to litigation, criminal actions or wage suits. Double damages are occasionally assessed for back wages found due by an inspector. Tips or complaints may arise from any of several sources–competitors, labor unions, employes or ex-employes. And a reinspection of the firm's records may occur at any time.

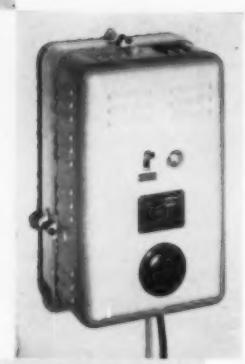
It will pay your employer to be generous in time and effort in keeping these records. They are not only helpful in avoiding possible legal entanglements but provide valuable information that will save him time and effort in the future. ■

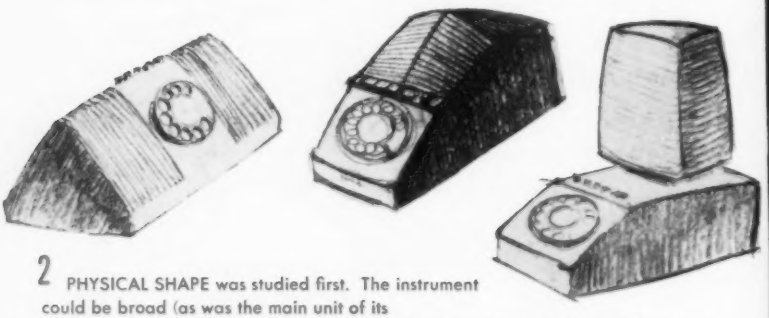


# from idea to form—
# EVOLUTION OF A LOUDSPEAKER TELEPHONE

E. J. TANGERMAN Editor

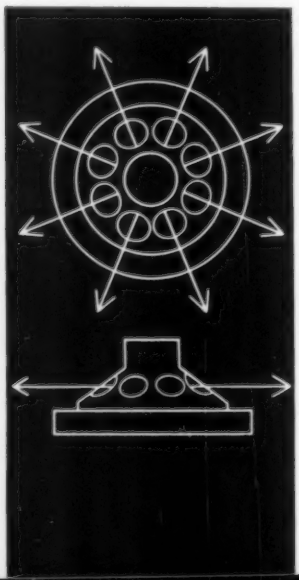
**Rarely are the development steps discernible after a new design is completed. However, in the new "distance-talking" telephone produced by Telefonaktiebolaget L. M. Ericsson, Stockholm, the collaboration of company engineers with the industrial-design firm of Ahlgren-Olsson-Silow, assisted by L. Dean Smith, is well documented. The result is a case study that outlines the approach to such a problem, and the solution—a desk unit that is compact, attractive and efficient. Pictures shown here represent only major steps of the many involved, and data are summarized from conferences with the creators. The new telephone is being announced this month.**



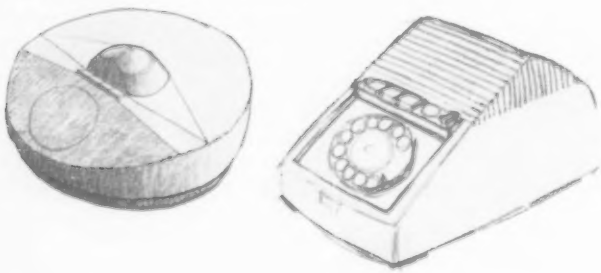


**1** FORMER LOUDSPEAKER TELEPHONE consisted of several units (as American models do): loudspeaker box, amplifier, and main instrument with handset. Technical study made possible radical reduction of component volume, suggested unitizing. It was decided the handset should be independent—the one-piece Ericofon, so the new unit would include loudspeaker, microphone, amplifier, dial and three operating buttons (switch, volume control and temporary cutout).

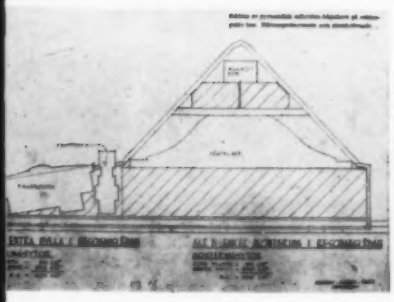
**2** PHYSICAL SHAPE was studied first. The instrument could be broad (as was the main unit of its predecessor—left), or long (middle). But both showed lack of balance because one dimension was exaggerated. When height was made the major dimension (right), shape was similarly unbalanced, and a basic concept was discovered—a loudspeaker telephone should propagate sound in all directions. Earlier types had not utilized the potentialities in this concept, because sound was received and emitted in one direction only. (Conventional methods of measuring transmission properties of this type of phone express this fact.) So it was decided that microphone and loudspeaker in the new design should be grouped for equal sound transmission in all directions, and that the form of housing should express this all-sidedness.

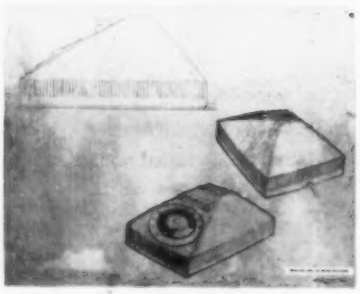


**3** A NEW FORM OF LOUDSPEAKER—inverted and set on a resonance box—was a technical innovation that obtained all-sidedness in speaker sound distribution

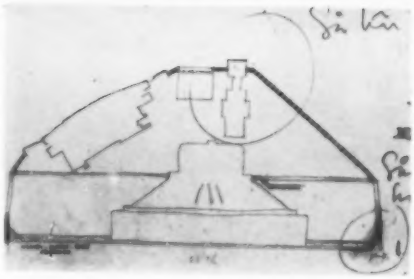


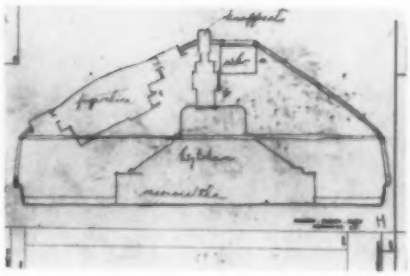
**4** TWO BASIC FORMS of all-sided instruments evolved from further study, the compact cubic shape (right), and the circular (left). The latter was theoretically the ideal form for all-sidedness, but it was difficult to place components inside without waste space, the instrument had a "spread-out" look and it covered too much desk area. So the rectangular base was chosen for development.





**5** GROUPING NECESSARY components compactly (cross-section) suggested a rectangular base and pyramidal top. Refining this form resulted in the sketch (right) that led to the final solution.

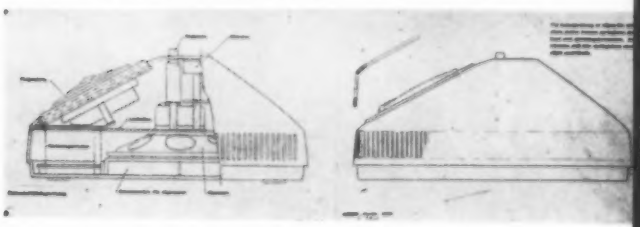




**6** SECTION STUDIES are supplemented with preliminary models of carboard (photo at top right). An attempt to place buttons behind the microphone (middle) and to detail the base as a square, is discarded for buttons in front, a rounded contour, and base in tray form to reduce height (bottom). Sound openings in the housing are now definitely fixed in planes at right angles to one another, and operating buttons are centered on top.

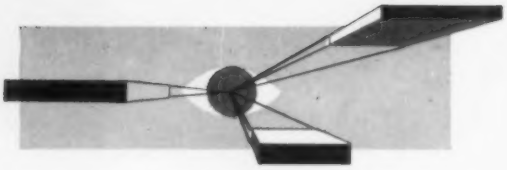
**7** MORE EXACT CARDBOARD MODELS are followed by a clay model. From the latter, a working drawing is made for a wood form, the form made, and warm sheet of polystyrene vacuum-formed over it.

**8** AGREEMENT IS REACHED on the essential shape, so detailed drawings of placement of housing-openings are made, as well as color studies and an assembly drawing. ▼



**9** NOW THE PROTOTYPE is made and tested with the handset to be used with it. Here is the final form, except that in mass production, openings will be formed directly as a part of the molding process, so final appearance of the slots will differ somewhat.

This industrial design feature takes the place of our regular "Trends in Appearance Design" section in this issue.



# POINTS

THE QUESTION:

***"Has Foreign Competition Affected the Design of Your Products?"***

**J. E. JASS**
Caterpillar Tractor Co.
Director of Engineering

## "We meet foreign competition . . .

with standard products designed for doing work that requires identical machine capabilities, regardless of the job location. Machines built by Caterpillar—tractors, motor graders, diesel engines and earthmoving equipment—are the results of continuous research and development over a period of more than 50 years. The design of a crawler tractor, for example, is not contingent upon the caprice of a style-conscious buyer. It is a capital good. The buyer of our type of machinery is interested in but one thing: knowing which machine will produce the greatest profit. Our goal is to help the owner lower costs and increase production by designing versatile machines that stay on the job.

"In recent years we have greatly expanded our foreign manufacturing operations. In so doing, we have extended our standards of quality so that they are equal in all our plants throughout the free world. Our new plant at Glasgow, Scotland, illustrates this policy. Machines to be manufactured there will be identical to those built in this country. The same applies to production of motor graders in our plant at Melbourne, Australia. Parts manufactured at Sao Paulo, Brazil, also follow our world-wide specifications."

**ROY D. CHAPIN, JR,**
Automotive Executive Vicepresident
and General Manager
American Motors Corp.

## "Our concept of compact and smaller automobiles . . .

has not been affected by the recent competition of foreign cars in the United States. In fact, as early as 1950, when the first Rambler was introduced, we began our pioneering effort to provide the American motorist with a car that made sense in the face of changing living habits. In launching our compact-car program, we decided to build a car that has the interior passenger comfort of the biggest American cars but without the excessive dead weight. By using single-unit construction and making the exterior of the car more compact, we cut down on weight, improve economy and performance and, at the same time, make the car much easier to handle and park.

"The idea made sense to us then—it still makes sense to us today. We saw a basic social and economic revolution taking place in American life, and the Rambler was geared to meet the sweeping changes that were gaining momentum. We plan to continue building the type of vehicles that will benefit the consumer as far as his 'personality' is concerned."

# OF VIEW

## "Very slightly . . . .

Foreign manufacturers are endeavoring to meet American-designed equipment rather than American builders designing equipment to meet foreign competition. American-made machine tools have always been heavier in construction, enabling them to take bigger cuts than foreign equipment in a shorter length of time. Foreign equipment has, in most instances, been a lighter type of machine selling at a much lower price. In recent years, foreign equipment has been built somewhat heavier and, in some cases, has been acceptable to American manufacturers. Where a buyer is more concerned about price rather than quality and performance, the foreign builders have been able to sell their equipment in the United States.

"The weight of our equipment has been increased by a minimum of 30% over equipment which we manufactured during World War II and, in some cases, we have actually doubled the weight, as compared with equipment built some 15 years ago. The main reason for this increase in weight is due directly to the higher production requirements of automotive and aircraft manufacturers, as well as the materials recently developed for use in the manufacture of aircraft and missiles.

"Importation of foreign machines into this country has become a much more serious problem than in the past because of the ridiculously low import duties imposed on foreign builders. Not many years ago imports into this country amounted to but a small fraction of domestic production. Today they amount to an average much higher than before. This is particularly true for manufacturers of standard-type equipment such as radial drills, lathes, milling machines, shapers, etc. On the other hand, export to foreign markets by American builders has been on the decline, due to the exceedingly high tariff placed on American-made machine tools imported by foreign countries. Some manufacturers of machine tools in the United States, in order to compete with foreign manufacturers, have built factories in Europe, making it possible to sell in European countries at a lower cost."

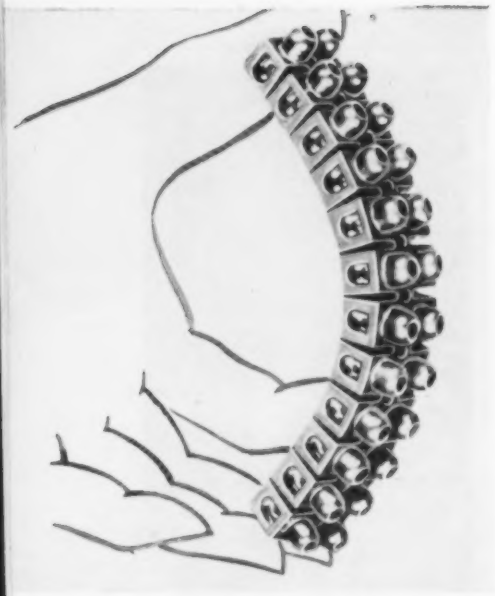
**J. E. STORM**
Vice-president and General Manager
Van Norman Machine Co.

## "Foreign competition has had no effect . . .

upon the design of our products, although we are cognizant of the design trends our foreign competitors are following. Design decisions at Argus are made on the basis of the improvements the innovations bring to product performance, serviceability and appearance, and to customer ease-of-operation.

"Despite the obvious advantage to foreign producers in lower production costs, we feel that the American products, in their price ranges, are second to none in quality of design and in serviceability. Precision design and manufacture of Argus cameras, projectors and related products, we feel, provides superior quality in their price range and results equal to or superior to products costing hundreds of dollars more."

**DUDLEY J. SCHOLTEN**
Divisional Vice-president—Marketing
Argus Cameras Div., Sylvania Products, Inc.



## Flexible terminal blocks . . .

are made of nonporous, flexible vinyl supplied in strips of 12 that can be cut to desired length with a pocketknife. Screws are fully enclosed in plastic molding, and a patented tapered head protects without washers. Heavy-duty nickel-plated hardware is embedded in plastic body. Terminals withstand continuous temperatures from —85 to 212 F. Resistance is 2.5 x $10^{15}$ per in., dielectric constant 3.5 at 60 cps. Terminals come in 10, 20, 30 and 50-amp capacities in double-barrier strips or in plug-type male and female pairs. Single-barrier strips with solder lugs are available in 20-amp size. Made in West Germany. From stock. List prices range from $1.12 to $3.75 per strip, depending on amp capacity. **American Electronic Products Co., 202 W. 40th St., New York City.**

Circle 1, Reader Service Card

## Digital shaft-angle encoder . . .

has built-in alignment cell for establishing accurate optical-mechanical concentricity to 110 parts/million and for testing operation performance. Readout is possible up to 100 complete digital words/sec max. Mechanical components are first assembled, followed by preloading bearings in exact mechanical environment in which they will operate; transparent coding disk having a cyclic binary pattern in 13 concentric tracks is then installed, mechanically aligned and sealed permanently in place. Electrical output is 5 v for a "1"; less than 50 milliv for a zero. Has a size-33 synchro mount; measures 3¾ x 7½ in. long; weighs 5 lb. Instruments are useful as feedback element in digital shaft-positioning servomechanisms, to couple rotating analog devices into digital computers, and for converting two-speed analog shaft data into a single, linear digital word for data processing. About $4000. 60 to 90-day delivery. **Dychro Corp., 125 Mt. Auburn St., Watertown 72, Mass.**

Circle 2, Reader Service Card

## Metal alloys are liquid . . .

at room temperature, but unlike mercury, demonstrate low vapor pressure, $10^{-7}$ mm Hg at temperatures to 932 F. Melting points of the two alloys are about 42.2 F and 60.8 F. Alloys are said to have excellent wetting properties and high surface tension, greater than 500 dynes/cm. Wetting is good on tungsten, rhenium, molybdenum, tantalum, beryllium, stainless steel, Pyrex, quartz and various ceramics without heat or flux. Especially suitable as high-vacuum-sealing compounds. Can be used in valves, motion seals, electrical contacts and similar applications. Seals can be used repeatedly. Price of seals per unit of length is said to compare favorably with gold wire seals. From stock. Quantity prices range from $2/gm for less than 100 gm to $1.40 for 1000 gm or more. **United Mineral & Chemical Corp., 16 Hudson St., New York 13.**

Circle 3, Reader Service Card

## Bonds of over 500 psi . . .

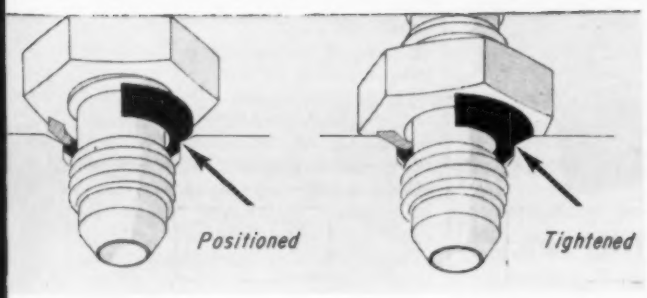
with aluminum and steel are possible with a one-component, epoxy-based adhesive. Comes ready to use and hardens permanently when cured with heat at 350 F for 25 to 40 min. Adhesive is a thick liquid, metallic colored, and can be applied to metal and heat-resistant nonmetals by brush, trowel, caulking gun or pressure feed systems. Surfaces to be joined do not require clamping or other mechanical fastening during the cure period. Bonds are said to be resistant to moisture, water, temperature changes, solvents and most chemicals. Test kits of 1 lb and a plastic squeeze dispenser are available at $5 each. **H. B. Fuller Co., 255 Eagle St., St. Paul 2.**

Circle 4, Reader Service Card

## Low-force snap switch . . .

requires less energy to deflect low gradient springs at given distance. Main blade of switch is constructed with spring force divided between two legs, one on each side of centerblade. Symmetrical construction eliminates bending moments, requires that the movable end travel in a straight line parallel to direction in which actuator pin moves. Linear motion gives closer movement differentials. Centerblade, under compression at all times, undergoes a bowing movement in section of spring behind contacts, causing contacts to move slightly in a lateral direction prior to tripping of mechanism. This contact wipe helps break minute welds caused when electric circuit is closed, and in handling of inductive loads. **Columbus Electric Mfg. Co., 2005 E. Main St., Columbus 5, Ohio.**

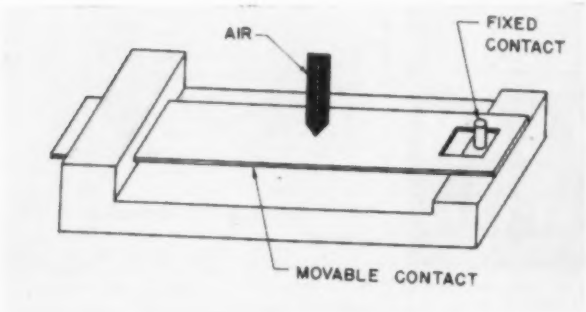
Circle 5, Reader Service Card




### Seals for hydraulic systems . . .

is effective from −360 to 1200 F, depending on whether it is made of aluminum, stainless steel or Inconel-X, and from 0 to more than 10,000 psi. Seal deforms and becomes an integral part of fitting with application of torque. Fitting has been disassembled repeatedly without loss of sealing efficiency. For ⅛ to 1-in. tubing. **Navan Products, 900 N. Sepulveda, El Segundo, Calif.**

Circle 6, Reader Service Card




### Air-jet-actuated switch . . .

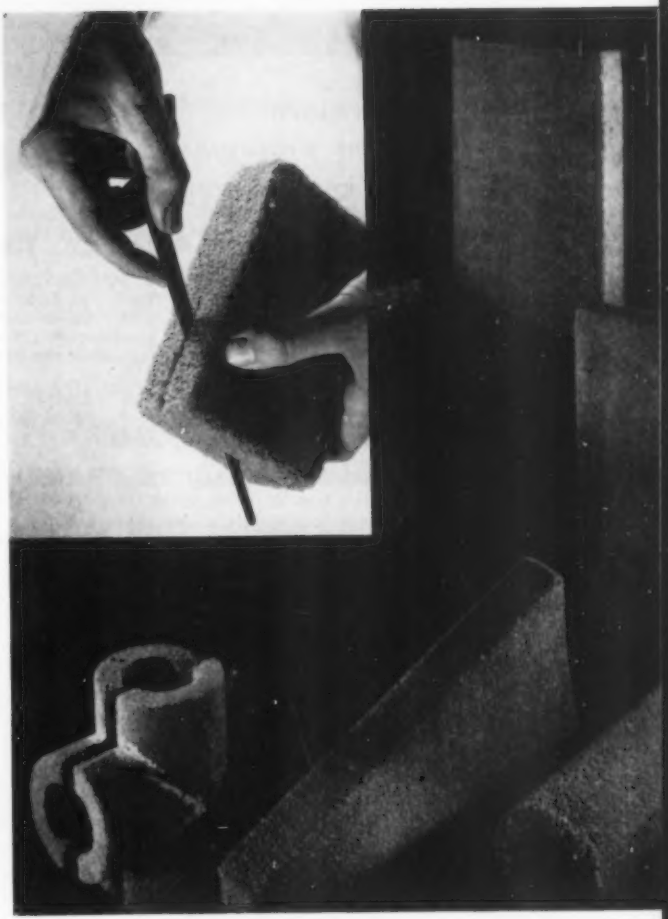
requires less than 20 microsec to break contact, and closes in about 40 microsec. Sampling speed is 20 rps max. Commutating and wiping action has been eliminated, resulting in a service-free life of more than 2000 hr. Metal contacts are mounted barrel-stave fashion around the drive shaft, and actuated by a rotating air jet that strikes them in rapid succession. Duty cycle can be set 30 to 90%. This unit, comprised of 45 isolated SPST normally-open contacts, combined as required, $1000. Delivery, 8 wk. **Norman Hardy Associates, P. O. Box 97, Wyncote, Penna.**

Circle 7, Reader Service Card

### High-strength plastic screws . . .

are threaded only as far as necessary for each application, resulting in greater strength and stiffness in unthreaded shanks. Unthreaded shanks are also available for use with speed nuts or clips. Each screw is individually torque tested. Impact strength is said to be six to eight times greater than nylon. Reported to have excellent dimensional stability at temperatures to 290 F. Available with any American standard thread size. $10 to $12 per 1000. 3 to 4-wk delivery. **Pylon Co., Attleboro, Mass.**

Circle 8, Reader Service Card



### Acid-resistant insulation . . .

is 99% pure fused silica that has been made to boil and foam. Material can neither oxidize nor absorb moisture; is unaffected by all acids with exception of hydrofluoric and hot phosphoric. Offers continuous insulating protection and withstands thermal shock within −450 to 2200 F. The 1 in. thickness is said to be equivalent to 18-in. acid brick at operating temperature of 250 F. Will not warp, shrink or slump during rapid temperature changes. When subjected to intense heat, then water-quenched, it does not crack or spall. Weighs 10 to 12 lb/cu ft. Compressive strength is 130 to 210 psi. Can be used as a load-bearing surface to eliminate some of the supporting and reinforcing structure required with conventional material. Available in blocks, 11 x 17 in. and 17 x 22 in., in thicknesses to 3 in. Approximate cost is 50¢ per board ft. Applications include: lining inside tanks and pipe lines; wick for transfer of inflammable liquid or gas to critical areas; lining for concrete, brick or steel stacks subjected to corrosive atmospheres; underground thermal and electrical insulation. **Pittsburgh Corning Corp., 1 Gateway Center, Pittsburgh 22.**

Circle 9, Reader Service Card

write for NEW
FREE
CATALOG

of Kendall—
Governaire
precision pneumatic
PRESSURE
REGULATORS for Industry

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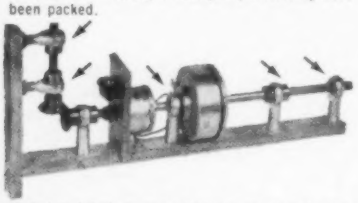

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SIGNIFICANT COMPONENTS
MATERIALS
PROCESSES . . .

### Miniature transistor-equipped counters . . .

are said to be low priced. Plug-in packages measure ⅞ x 2⅝ in. high. Fit a standard 9-pin noval tube socket. Packaging style utilizes printed circuit techniques with commercial-size components embedded in a thermosetting epoxy resin. Exceeds all applicable military specifications. First unit to be introduced is a binary counter that operates at repetition rates over 800 k. Where a standard decade divider is required, four of the binaries can be provided, complete with preassembled and prewired printed-circuit-mounted plug-in sockets. **Walkirt Co., 141 W. Hazel St., Inglewood 3, Calif.**

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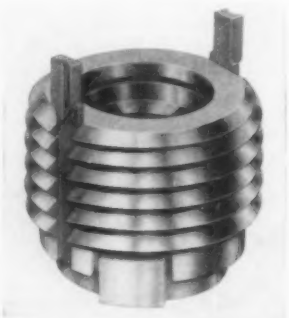

### Self-aligning threaded insert . . .

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### Governor-controlled motor . . .

for 27-v, dc, precision timing applications is currently undergoing testing for approval under military specifications. Motor has passed preliminary testing within 1¾% ± max error over 24 to 30-v range, —35 to 140 F, under shock and vibration conditions. **Hansen Mfg. Co., Princeton, Ind.**

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# PRODUCT-DESIGN MEMOS FROM DUREZ

**Heavy-duty parts**
**Making epoxies flame-resistant**

**Metallized phenolics**

Chrysler Corporation

## Rugged

Got a job that's "too tough for phenolics"?

You might never think of phenolic for a part like this Chrysler-engineered automotive oil-pump gear—subject to wear, heat, friction, constant oil immersion.

But you'd be reckoning without the ruggedness of a new phenolic, *Durez 16771*.

Parts molded from this glass-fiber-filled compound have a flexural strength of 20,000 psi, compressive strength of 16,500 psi. Their tensile strength is 7,000 psi. Modulus of elasticity in tension is $3.0 \times 10^6$ psi. What's more, the heat distortion point of these parts is up around 600° F.

**Payoff** • These properties, plus excellent resistance to oil, water, and acid, made Durez 16771 appear to have some of the properties needed for the Chrysler oil-pump gear. After extensive experimenting and testing, Chrysler engineers developed the plastic gear to replace the usual metal part.

Results: *new gears of Durez 16771 outwear metal gears nearly 3 to 1—show no performance-affecting wear after 200,000 miles; save about two-thirds of the cost of metal gears; run more quietly.*

For a data sheet describing this high-strength phenolic, check opposite "16771" on the coupon.

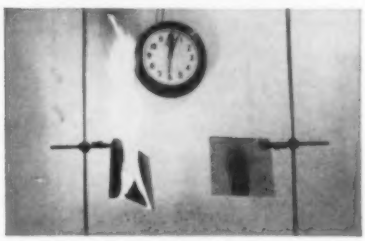
## How to make epoxies resist flame

Your epoxy laminates and castings will shrug off heat, moisture—even fire—if you cure them with a new Durez product called HET® Anhydride.

In the picture that follows, the laminate cured with a conventional hardener ignites in less than 30 seconds and burns to destruction in about 3 minutes. Exposed to a similar flame source for the same time, a HET-cured laminate snuffs itself out as soon as the flame source is removed.

This leads to some interesting possibilities. For instance, you can now make glass-reinforced laminates that keep practically all their flexural strength, *even when heated within the 300-350° F range.*

You can make potting resins that retain room-temperature electrical properties at high humidities *and at temperatures above 300°F*—and won't feed a fire.



For easier casting or wet layup, you need not handle HET Anhydride hot. You can mix it with another anhydride to form a curing system that *stays liquid at room temperature.* Toxicity is very low.

If you'd like complete information on HET Anhydride, methods of use, and properties of cured resins, check the coupon for Bulletins 19 and 43.

## Bright idea

Next time you want to put a bright reflective surface on a part, think of *metallized phenolic.* It may save you a costly production step.

American Optical Company

For instance, this housing for a microscope lamp requires a mirror to focus the light.

To sidestep the cost of a custom-made mirror, the housing is molded of Durez phenolic. Then an aluminum mirror is deposited right on the plastic by vacuum evaporation.

This is easy to do with the Durez compound chosen for this part. It provides a good hard surface for metallizing. It incorporates other wanted properties: high impact strength and low thermal conductivity.

**You're on sure ground** when you base bright ideas like this on phenolics. They give you a bigger choice of controlled properties than any other material in their class. You can select the right balance from *more than 150 Durez compounds.*

To take a fresh look at today's phenolics, just check the coupon for a new four-page bulletin describing some typical Durez molding compounds and what you can do with them.

**For more information** on Durez materials mentioned above, check here:

- ☐ High-impact Durez 16771
- ☐ HET Anhydride—Bulletins 19 and 43
- ☐ Phenolic molding compounds—descriptive bulletin

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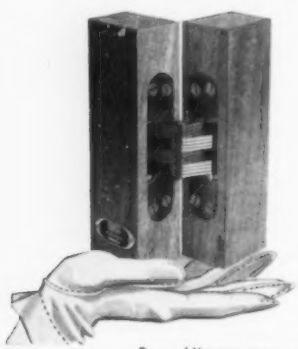

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for transistors, rectifiers and other miniature electronic and electrical components conducts heat away through thermal contact with a finned plate. Available in two module sizes, 2½ and 3¾ in., with up to six units in a continuous strip. **Electronic Cooling Dept., Modine Mfg. Co., 1500 De Koven Ave., Racine, Wis.**

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# NEW LITERATURE

## Mysteries of Science

**JOHN ROWLAND.** ***Published by Philosophical Library, Inc., 15 E. 40th St., New York 16. 6x9, 214 pp. $6.***

The author states his purpose in the preface: to rebutt "the outright claim that science can solve all problems, (and) answer all needs." He then quickly concedes that this is not the opinion of anyone in particular, but that it has been "more or less implied by many recent writers, and needs consideration." With this imaginary challenge, Mr. Rowland dons the role of defender of the faith and proceeds to point out that in many fields of science there are certain unsolved "mysteries." These mysteries are sniffed out as if few people are aware of their existence and as if there is a conspiracy (by scientists) to hide unsolved problems.

Here, then, is the typical science mistruster. Sandwiched in what is ostensibly a survey of problems that confront physicists, biologists, psychologists and sociologists, are potshots at the men who dare tackle these problems. Mr. Rowland, a British theologian and science writer, is frankly annoyed with the credit to science. He asks: "Why has science acquired such an overwhelming prestige in our day? . . . (when if) all the impressive achievements of science are examined a little more closely, it is seen that they are not impressive, save in the sense of being highly ingenious 'gadgets'."

He ominously predicts that the world is in for a bad time unless scientists come to see their limitations and continuously attributes pompous and rather stupid statements to scientists and fellow travellers without revealing the source—then gleefully tears the statements apart. For example, he says: "There is the assumption that the scientific analysis of the world provides the whole truth about the world and that those things which do not fit must be mistaken or untrue." Naturally this statement is an easy target—but who said it in the first place? Why, "orthodox rationalists," that's who.

This book may be of some value to those who are trying to understand the growing antipathy toward science in the face of the most successful progress the world has ever seen. When barriers are rapidly being brushed aside, when all new concepts, no matter how unorthodox, are examined enthusiastically, why do some learned men painstakingly put all their efforts to show that science is following a narrow and false trail? One is reminded of the aphorism: "If you can't fight them, join them." Possibly it has been more apropos in this case to say "If you can't join them, fight them."

—NC

## Art and the Engineer

The special responsibility of engineers and scientists to acquire the fullness of outlook that awareness and understanding of the arts contributes is discussed by the author, who states, "Both art and science concern themselves with bringing order out of disorder, coherence out of chaos. . . . It is the human eye that sees in art; in science it is the human eye looking through a lens that sees."

***Abstracted from "Art and the Engineer" by William Geoffrey; Journal of Engineering Education, May '58, Prince and Lemon St., Lancaster, Penna.***

**ALLOY FABRICATION**—Booklet, 30 pp. A guide for purchasing complex and unusual alloy sheet and light plate structures. Describes and illustrates products and fabricating techniques, and includes design pointers. S. Blickman, Inc., 8400 Gregory Ave., Weehawken, N. J.

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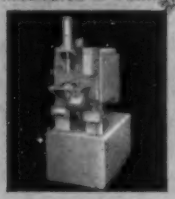

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# Publisher's Postscript...

## we watch the BELLWETHERS

"Aren't you putting too much editorial material pertaining to aircraft, missiles, and rockets into *Product Engineering*? I've subscribed a long time, but I see very little in your paper about designing printing presses. My job deals entirely with printing press design," a subscriber wrote recently.

But technological and engineering progress moves so fast these days that knowing all about one's specific field is not enough. The seasoned engineer is expected to have the answers to questions that embrace the whole field of design engineering progress. At least he should know what's going on in the various fast-moving fields of design progress even though outside his immediate interests. Because that's where he'll find the new ideas or the new materials or the components he can put to use to help solve his own problems.

The aircraft industry (aircraft, missiles, rockets) today is regarded as a major bellwether in engineering progress. Many of its methods, materials, and processes have much promise for application in other fields. That's why our editors have followed developments in this field closely. Only a modest percentage of our subscribers are directly concerned with this industry's day-to-day design problems, but the editors believe all our readers want to know about significant developments that might have application elsewhere.

A good illustration is the article "BELLWETHER WITH WINGS" that appeared in the July 7 issue. This field report described 26 new areas of development in fabrication, materials and processes, by the aircraft industry, selected because of their probable applicability in other fields of product design.

To get this story, editors traveled about 7,500 miles in 2½ weeks, visiting aircraft builders in San Diego, Los Angeles, Seattle, San Francisco, Dallas and Ft. Worth. They talked with dozens of engineers at 14 plants, asking each the same question, "Which recent developments in aircraft materials and processes are likely to have the greatest impact on product design throughout industry?" The finished manuscript was checked and corrected at 13 of the plants.

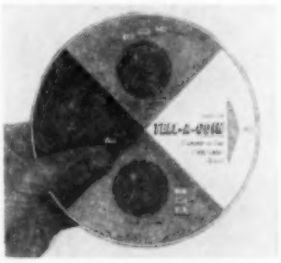
This important information is condensed into only 6 pages. It's full of meat and ideas. It cost a lot of money to get, but it's typical of the kind of reporting the editors are doing for you. It's exclusive—you won't see it anywhere else. If you haven't already read it, reach for the July 7 issue and read it.

Another illustration—the most significant progress in the use of adhesives comes out of the aircraft industry. We have published many articles explaining how these techniques can be applied in other product designs. The result—an avalanche of requests for reprints.

I guess maybe we have paid more attention to the aircraft industry, the machine-tool industry, and perhaps to developments in foreign countries than you'll find in the average design-engineering publication. But we do it for a definite reason—to bring you the best information . . . the newest ideas . . . the latest methods from the fast-moving fields of product design . . . that we believe will help you with your own problems, whether you design a turbine, an air compressor, a lawn mower, or any other engineered product.—A. H.

# 74 for your information (personal)

## Hidden profit in your pocket?



Are those pennies, nickels, dimes and quarters jangling around in your pants worth more than their face value? You don't have to be a walking numismatic catalog to be sure. Taking a dial from the engineer's portfolio, Discalog, Inc., PO Box 36432, Los Angeles 36, has designed a set of guide wheels that have practically all the answers. Just turn the dial to indicate the mint, year, and condition, and the current price appears in the proper box. A 1927 dime in good condition, for instance, is worth about 40¢ if it was minted in Philadelphia, $2.25 if it came from Denver.

Each Tell-a-coin guide wheel has the data on two coins. Right now, the penny-nickel and dime-quarter wheels are available at $2 for the set. Others will be offered in the next six months.

Time-saving tip: Don't bother looking at dimes minted since 1936 unless they're in choice condition (uncirculated), or carry the 1941-42 designation. The latter, the wheel says, is worth $10; the rest, just 10¢.

## Ah, precious ($125) sleep!

If a good night's sleep is worth a million dollars, then perhaps this new electronic gadget is a bargain. Combining 7 transistors, a hi-fi speaker and a push-pull output in a case 3 by 6 by 14 in., it weighs just 4 lb, is powered by 4 flashlight batteries, costs $125.

What does this electronic effort do? It reproduces the sound of falling rain. Says the manufacturer, Gardiner Electronics Co.: "The sleep response to the sound of falling rain is probably a primitive instinct and its presence in most people was borne out by a survey. The Sleepatron . . . stimulates this primitive instinct to sleep with the hypnotic sound of rainfall . . . and will eliminate the need to take harmful and dangerous drugs." You can adjust the volume too—to drown out extraneous noises.

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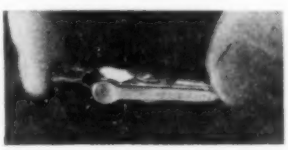

Want a new gold-plated tie clip like the one pictured here? Just ask for it. Mueller Electric Co. had them made up as souvenirs of its 50th anniversary in the electric clip business, is offering them free of charge to engineers. Address: Mueller Electric Co., 1552W East 31st St., Cleveland 14.


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. . . for soft-drink machines, a system of cooling the bottles on demand rather than all the time. The cost of electrical power, on hot summer nights when the machines are not in use and on days when drinks aren't selling, could be completely eliminated. How about a $CO_2$ bottle with a jet outlet near the exit chute for the necessary quick chill?

—C. McMahon

. . . a radio clock in which indicated time would be controlled by coded pulses sent out by radio stations. The received signal would be decoded in the normal radio circuits and then used to control clock hands. Whenever accuracy of clock is questioned it would only be necessary to turn on the radio for a few moments until the clock corrected itself. —B. Marie

. . . a mechanical brake for small power boats, controlled by a foot pedal. Cables could pull a plastic or metal dish below the stern to stop forward motion.

—R. J. Reichert

. . . a V-belt made with five sides instead of the usual four. A standard belt usually fails by wearing through the two working sides. With a pentagonal cross section the belt could be rotated periodically to distribute the wear equally on all sides. —H. Koslow

. . . a portable, heavy-duty air circulator with filter system designed to clear smoke from conference rooms and offices. Often the air conditioner is severely overloaded and at best it is intended to cool rather than filter down to smoke-size particles. The unit should be quiet, with easily replaced or washable filters, and sell for under $200. —C. L. Robinson

**Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer**

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